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# **STRUCTURAL CALCULATIONS**

# FOR THE PROPOSED CANOPIED EXTENSION

<u>AT</u>

## **WILLINGTON SPORTS PAVILLION**

## TWYFORD ROAD

## **WILLINGTON**

# **DERBYSHIRE**

THESE CALCULATIONS HAVE BEEN PREPARED IN ACCORDANCE WITH THE RELEVANT PARTS OF THE FOLLOWING BRITISH STANDARD CODES OF PRACTICE:-

- 1. BS 6399 "LOADINGS FOR BUILDINGS"
- 2. BS 5950 "STRUCTURAL USE OF STEELWORK"
- 3. BS 5628 "UNREINFORCED MASONRY"

JOB REF: 6000 DATE: JUNE 2023

|  | Project  |              |                |      | Job Ref.       |      |
|--|----------|--------------|----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion |      | 60             | 000  |
| CONSULTING                                   | Section  |              |                |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      |                | 1    |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                |      |                |      |

### INTRODUCTION

We have been instructed by Willington Parish Council to prepare the structural calculations for the proposed canopied extension at Willington Sports Pavillion, Twyford Road, Willington.

In order to carry out the above we have been provided with architectural drawings prepared by Making Plans Architecture, no pre-alteration survey has been conducted by this office.

The design covers the steelwork support to the canopied roof. The roof is trussed rafters, designed and manufactured by a truss manufacturer. Our calculations assume that the trusses are positively fixed to the steelwork, that the roof is braced in accordance with BS5268 and that the ceiling acts as a rigid diaphragm.

Beam spans shown in these calculations are for design purposes only and so all dimensions should be checked on site by the builder prior to the fabrication of steelwork.

The heaviest beam specified in these calculations will weigh approximately 250 kg, the building contractor should ensure they have appropriate lifting gear for the safe installation of the steelwork.

All structural steelwork to be grade S355 and hot rolled. Plates are grade 275.

Due to its external location we also recommend the steelwork is hot dip galvanised.

These calculations have been prepared for Building Regulation purposes, and should be read in conjunction with the Architects drawings, and our mark up plan, any discrepancies should be reported immediately to this office.

Bayliss Consulting have not been asked to design the temporary works for the project. The builder is to provide adequate temporary propping to ensure the stability of the structure during the work.

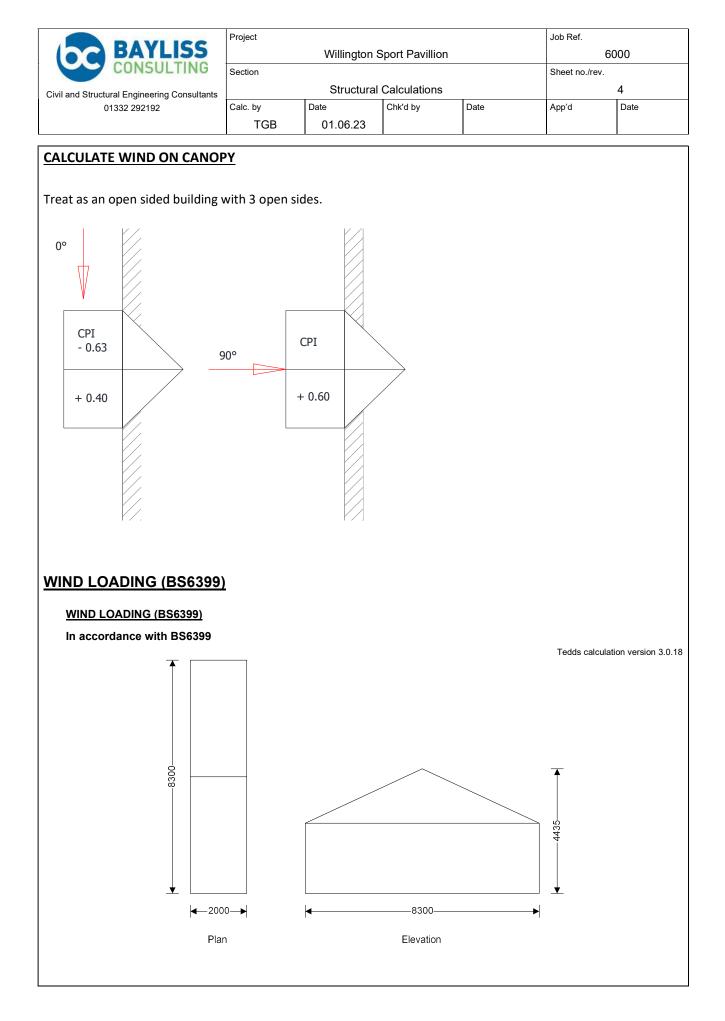
Minor post – construction cracking of brittle finishes may occur.

|                | DAVIDES                           | Project         |                  |                       |                       | Job Ref.      |      |
|----------------|-----------------------------------|-----------------|------------------|-----------------------|-----------------------|---------------|------|
|                | BAYLISS                           |                 | Willington S     | port Pavillion        |                       |               | 6000 |
|                | CONSULTING                        | Section         |                  |                       |                       | Sheet no./rev |      |
| Civil and St   | tructural Engineering Consultants |                 | <b>1</b>         | Calculations          |                       |               | 2    |
|                | 01332 292192                      | Calc. by<br>TGB | Date<br>01.06.23 | Chk'd by              | Date                  | App'd         | Date |
|                |                                   | IGB             | 01.00.23         |                       |                       |               |      |
| STRUCT         | URE LOADS                         |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
| Roof           |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                | S = <u>0.75 kN/m²</u>             |                 |                  |                       |                       |               |      |
|                | D = Tiles                         |                 | = 0.65 kN/m      | 2                     |                       |               |      |
|                | Battens                           |                 | = 0.03 kN/m      |                       |                       |               |      |
|                | Felt                              |                 | = 0.02 kN/m      |                       |                       |               |      |
|                | Rafters                           |                 | = 0.10 kN/m      |                       | <u>0.80 kN/m²</u>     |               |      |
|                |                                   |                 | ,                |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
| <b>Ceiling</b> |                                   |                 |                  |                       |                       |               |      |
|                | C 0.25 LN /m <sup>2</sup>         |                 |                  |                       |                       |               |      |
| -              | $S = 0.25 \text{ kN/m}^2$         |                 |                  |                       |                       |               |      |
|                | D = Joists                        |                 | = 0.10 kN/m      | 2                     |                       |               |      |
|                | Insulation                        |                 | = 0.05 kN/m      | 2                     |                       |               |      |
|                | Ceiling Board                     |                 | = 0.15 kN/m      | 2                     |                       |               |      |
|                | Services                          |                 | = 0.05 kN/m      | <sup>2</sup> <u>=</u> | <u>0.35 kN/m²</u>     |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
| Stud Wa        | <u>all</u>                        |                 |                  |                       |                       |               |      |
|                |                                   |                 | 0.45101/         | 2                     |                       |               |      |
|                | D = Studs                         |                 | = 0.15 kN/m      |                       |                       |               |      |
|                | Insulation                        |                 | = 0.05 kN/m      |                       |                       |               |      |
|                | Ply Sheathing a                   |                 |                  |                       | $0.75 \text{ kN}/m^2$ |               |      |
|                | Timber Claddin                    | 8               | = 0.25 kN/m      | - <u>-</u>            | <u>0.75 kN/m²</u>     |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
|                |                                   |                 |                  |                       |                       |               |      |
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|                |                                   |                 |                  |                       |                       |               |      |
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|                |                                   |                 |                  |                       |                       |               |      |
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| L              |                                   |                 |                  |                       |                       |               |      |

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|  | Project  |              |                 |      | Job Ref.       |      |
|--|----------|--------------|-----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | Sport Pavillion |      | 60             | 000  |
| CONSULTING                                   | Section  |              |                 |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations    |      |                | 3    |
| 01332 292192                                 | Calc. by | Date         | Chk'd by        | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                 |      |                |      |

| DE65 6BN    |
|-------------|
| SK298285    |
| 45 Metres   |
| Countryside |
| 125m        |
| 21.40 m/sec |
|             |



| Civil and Structural Engineering Consultants  | Project<br>Section  |               | Sport Pavillion |      | Job Ref. Sheet no./rev. | 6000<br>5 |
|---|---|---------------|-----------------|------|-------------------------|-----------|
| 01332 292192  | Calc. by<br>TGB   | Date 01.06.23 | Chk'd by        | Date | App'd                   | Date      |
| <b>Building data</b><br>Type of roof<br>Length of building<br>Pitch of roof<br>Reference height | Duopitch<br>L = <b>2000</b> mm<br>α <sub>0</sub> = <b>25.0</b> deg<br>H <sub>r</sub> = <b>4435</b> mm |               | Width of build  | ing  | W = <b>8300</b> m       | ım        |

| Dynamic classification         |                              |                                |                                  |
|--------------------------------|------------------------------|--------------------------------|----------------------------------|
| Building type factor (table 1) | K <sub>b</sub> = <b>4.0</b>  | Dynamic augmentation factor    | (1.6.1) Cr = <b>0.05</b>         |
| Site wind speed                |                              |                                |                                  |
| Location                       | Willington                   | Basic wind speed               | V <sub>b</sub> = <b>21.4</b> m/s |
| Site altitude                  | ∆s <b>= 45</b> m             | Upwind dist from sea to site   | d <sub>sea</sub> = <b>125</b> km |
| Direction factor               | S <sub>d</sub> <b>=1.00</b>  | Seasonal factor                | S <sub>s</sub> = 1.00            |
| Probability factor             | S <sub>p</sub> = <b>1.00</b> | Critical gap between buidlings | g = <b>5000</b> mm               |
| Topography not significant     |                              |                                |                                  |
| Altitude factor                | Sa = 1.05                    | Site wind speed                | V <sub>s</sub> = <b>22.4</b> m/s |
| Terrain category               | Country                      |                                |                                  |
| Displacement height            | $H_d = 0mm$                  |                                |                                  |

The velocity pressure for the windward face of the building with a 0 degree wind is to be considered as 2 parts as the height h is greater than b but less than 2b (cl.2.2.3.2)

| e windward face of the                      | building with a 90 degree wind is to b   | e considered as 1 part   |
|---|--|--|
| 1.2.2.3.2)                                  |  |  |
| rd wall (lower part) - W                    | /ind 0 deg   |  |
| H <sub>e</sub> = <b>2000</b> mm             |  |  |
| Sc = <b>0.723</b>                           | Turbulence factor (Table 22)   | St = <b>0.215</b>  |
| g <sub>t</sub> = <b>3.44</b>                | Terrain and building factor  | S <sub>b</sub> = <b>1.26</b>   |
| V <sub>e</sub> = <b>28.1</b> m/s            | Dynamic pressure   | qs = <b>0.485</b> kN/m <sup>2</sup>  |
| rd wall (upper part) - W                    | /ind 0 deg and roof  |  |
| H <sub>e</sub> = <b>2500</b> mm             |  |  |
| Sc = <b>0.750</b>                           | Turbulence factor (Table 22)   | St = 0.211   |
| gt = <b>3.44</b>                            | Terrain and building factor  | S <sub>b</sub> = 1.29  |
| V <sub>e</sub> = <b>28.9</b> m/s            | Dynamic pressure   | q <sub>s</sub> = <b>0.513</b> kN/m <sup>2</sup>  |
| rd wall - Wind 90 deg a                     | ind roof   |  |
| H <sub>e</sub> = <b>4435</b> mm             |  |  |
| Sc = <b>0.852</b>                           | Turbulence factor (Table 22)   | St = <b>0.196</b>  |
| gt = <b>3.44</b>                            | Terrain and building factor  | S <sub>b</sub> = <b>1.43</b>   |
| V <sub>e</sub> = <b>31.9</b> m/s            | Dynamic pressure   | qs = <b>0.625</b> kN/m <sup>2</sup>  |
|   |  |  |
| a <sub>eg</sub> = <b>8.7</b> m              | Exte size effect factor  | C <sub>aeg</sub> = <b>0.958</b>  |
| a <sub>es</sub> = <b>3.2</b> m              | Exte size effect factor  | C <sub>aes</sub> = 1.000   |
| a <sub>er</sub> = <b>5.0</b> m              | Exte size effect factor  | Caer = 1.000   |
| e a <sub>eus</sub> <b>= 2.1</b> m           | Exte size effect factor  | Caeus = 1.000  |
| side  | a <sub>ebs</sub> = <b>2.8</b> m  | Exte size effect factor  |
| Caebs = 1.000                               |  |  |
| V <sub>i</sub> = <b>40.0</b> m <sup>3</sup> | Diag dim for int size effect   | a <sub>i</sub> = <b>34.2</b> m   |
| C <sub>ai</sub> = <b>0.855</b>              |  |  |
|   |  |  |
| р   | = $q_s \times c_{pe} \times C_{ae}$ - $q_s \times c_{pi} \times C_{ai}$  |  |
|   | I.2.2.3.2)<br>rd wall (lower part) - W<br>$H_e = 2000 \text{ mm}$<br>$S_c = 0.723$<br>$g_t = 3.44$<br>$V_e = 28.1 \text{ m/s}$<br>rd wall (upper part) - W<br>$H_e = 2500 \text{ mm}$<br>$S_c = 0.750$<br>$g_t = 3.44$<br>$V_e = 28.9 \text{ m/s}$<br>rd wall - Wind 90 deg a<br>$H_e = 4435 \text{ mm}$<br>$S_c = 0.852$<br>$g_t = 3.44$<br>$V_e = 31.9 \text{ m/s}$<br>$a_{eg} = 8.7 \text{ m}$<br>$a_{es} = 3.2 \text{ m}$<br>$a_{er} = 5.0 \text{ m}$<br>$e$ $a_{eus} = 2.1 \text{ m}$<br>side<br>$C_{aebs} = 1.000$<br>$V_i = 40.0 \text{ m}^3$<br>$C_{ai} = 0.855$ | rd wall (lower part) - Wind 0 deg $H_e = 2000 \text{ mm}$ $S_c = 0.723$ Turbulence factor (Table 22) $g_t = 3.44$ Terrain and building factor $V_e = 28.1 \text{ m/s}$ Dynamic pressurerd wall (upper part) - Wind 0 deg and roof $H_e = 2500 \text{ mm}$ $S_c = 0.750$ Turbulence factor (Table 22) $g_t = 3.44$ Terrain and building factor $V_e = 28.9 \text{ m/s}$ Dynamic pressurerd wall - Wind 90 deg and roof $H_e = 4435 \text{ mm}$ $S_c = 0.852$ Turbulence factor (Table 22) $g_t = 3.44$ Terrain and building factor $V_e = 31.9 \text{ m/s}$ Dynamic pressure $a_{eg} = 8.7 \text{ m}$ Exte size effect factor $a_{es} = 3.2 \text{ m}$ Exte size effect factor $a_{es} = 3.2 \text{ m}$ Exte size effect factor $a_{eus} = 2.1 \text{ m}$ Exte size effect factor $a_{ebs} = 2.8 \text{ m}$ Caebs = 1.000 $V_i = 40.0 \text{ m}^3$ Diag dim for int size effect |

|   | AYLISS   | Project  | Willington Sport  | Pavillion   |   |   | Job Ref.   | 6000  |
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| C   | DNSULTING  | Section  |   |   |   |   | Sheet no.  |   |
|   | ngineering Consultants   |  | Structural Calc   |   | Data  |   | A  | 6   |
| 01332   | 292192   | Calc. by I<br>TGB  | Date Chk<br>01.06.23  | d by  | Date  |   | App'd  | Date  |
|   |  | IGB  | 01.00.23  |   |   |   |  |   |
| Net force   |  |  | $F_w = p \times A_{ref}$  |   |   |   |  |   |
| Roof load c   | ase 1 - Wind 0, c <sub>pi</sub> .  | -0.63, + c <sub>pe</sub>   |   |   |   |   |  |   |
| Zone  | Ext<br>pressure<br>coefficient,<br>C <sub>pe</sub>   | Dynamic<br>pressure, q₅<br>(kN/m²)   | External<br>size factor,<br>C <sub>ae</sub>   | Net<br>Pressu<br>p (kN/                                 | ıre,  | Are<br>A <sub>ref</sub> (                                     | -  | Net force,<br>F <sub>w</sub> (kN)                                     |
| A (+ve)   | 0.60   | 0.62   | 1.000   | 0.7   | 1   | 0.4   | 14   | 0.31  |
| C (+ve)   | 0.33   | 0.62   | 1.000   | 0.54  | 4   | 8.7   | 2  | 4.75  |
| E (+ve)   | -1.03  | 0.62   | 1.000   | -0.3  | 1   | 0.4   | 14   | -0.14   |
|   |  |  |   |   |   |   |  |   |
| G (+ve)<br>Total vertica  | -0.50<br>I net force   | 0.62<br>F <sub>w,v</sub> = <b>4.65</b> kN  | 1.000<br>Tot  | 0.02<br>al horizontal                                   |   | 8.7<br>ce F   | 72<br>F <sub>w,h</sub> = <b>2.</b>   | 0.21<br><b>11</b> kN  |
| Total vertica   |  | F <sub>w,v</sub> = <b>4.65</b> kN  | Tot<br>External<br>size factor,   | Al horizontal   | t<br>net forc   |   | F <sub>w,h</sub> = <b>2</b> .  |   |
| Total vertica<br>Roof load c  | net force<br>ase 2 - Wind 0, c <sub>pi</sub> (<br>Ext<br>pressure  | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q <sub>s</sub>   | Tot   | al horizontal   | t<br>net forc   | ce F  | F <sub>w,h</sub> = <b>2</b> .  | 11 kN<br>Net force,   |
| Total vertica<br>Roof load c  | net force<br>ase 2 - Wind 0, c <sub>pi</sub><br>Ext<br>pressure<br>coefficient,  | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q <sub>s</sub>   | Tot<br>External<br>size factor,   | Al horizontal   | t<br>met ford<br>t<br>m <sup>2</sup> )                              | ce F  | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )   | 11 kN<br>Net force,   |
| Total vertica<br>Roof load c<br>Zone  | ase 2 - Wind 0, c <sub>pi</sub><br>Ext<br>pressure<br>coefficient,<br>C <sub>pe</sub>  | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> pe<br>Dynamic<br>pressure, q₅<br>(kN/m²)   | Tot<br>External<br>size factor,<br>Cae  | Net<br>Pressu<br>p (kN/                                 | t<br>m <sup>2</sup> )   | ce F<br>Are<br>A <sub>ref</sub> (                             | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )   | 11 kN<br>Net force,<br>F <sub>w</sub> (kN)                            |
| Total vertica<br>Roof load c<br>Zone<br>A (-ve)   | ase 2 - Wind 0, c <sub>pi</sub> (<br>Ext<br>pressure<br>coefficient,<br>c <sub>pe</sub><br>-0.70                                       | F <sub>w,v</sub> = <b>4.65</b> kN<br>0.40, - c <sub>pe</sub><br>Dynamic<br>pressure, q₅<br>(kN/m <sup>2</sup> )<br>0.62  | Tot<br>External<br>size factor,<br>Cae<br>1.000   | Net<br>Pressu<br>p (kN/<br>-0.6                         | t<br>Inet ford<br>t<br>Ire,<br>m <sup>2</sup> )<br>5<br>8           | ce F<br>Are<br>A <sub>ref</sub> (<br>0.4                      | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )<br>44<br>72   | 11 kN<br>Net force,<br>F <sub>w</sub> (kN)<br>-0.29                   |
| Total vertica<br>Roof load c<br>Zone<br>A (-ve)<br>C (-ve)  | net force<br>ase 2 - Wind 0, c <sub>pi</sub> (<br>Ext<br>pressure<br>coefficient,<br>c <sub>pe</sub><br>-0.70<br>-0.27                 | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q₅<br>(kN/m <sup>2</sup> )<br>0.62<br>0.62   | Tot<br>External<br>size factor,<br>Cae<br>1.000<br>1.000  | Net<br>Pressu<br>p (kN/<br>-0.6<br>-0.3                 | t<br>m <sup>2</sup> )<br>5<br>6                                     | 20 F<br>Are<br>A <sub>ref</sub> (<br>0.4<br>8.7<br>0.4<br>8.7 | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )<br>44<br>72<br>44   | Net force,<br>F <sub>w</sub> (kN)<br>-0.29<br>-3.31<br>-0.38<br>-4.58 |
| Total vertica<br>Roof load c<br>Zone<br>A (-ve)<br>C (-ve)<br>E (-ve)                             | ase 2 - Wind 0, c <sub>pi</sub><br>Ext<br>pressure<br>coefficient,<br>c <sub>pe</sub><br>-0.70<br>-0.27<br>-1.03<br>-0.50              | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q <sub>s</sub><br>(kN/m <sup>2</sup> )<br>0.62<br>0.62<br>0.62                                   | External           size factor,           Cae           1.000           1.000           1.000           1.000 | Net<br>Pressu<br>p (kN/<br>-0.6<br>-0.3<br>-0.8         | t<br>met ford<br>t<br>m <sup>2</sup> )<br>5<br>8<br>6<br>3          | 20 F<br>Are<br>A <sub>ref</sub> (<br>0.4<br>8.7<br>0.4<br>8.7 | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )<br>14<br>72   | Net force,<br>F <sub>w</sub> (kN)<br>-0.29<br>-3.31<br>-0.38<br>-4.58 |
| Total vertica<br>Roof load c<br>Zone<br>A (-ve)<br>C (-ve)<br>E (-ve)<br>G (-ve)<br>Total vertica | ase 2 - Wind 0, c <sub>pi</sub><br>Ext<br>pressure<br>coefficient,<br>c <sub>pe</sub><br>-0.70<br>-0.27<br>-1.03<br>-0.50              | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q₅<br>(kN/m <sup>2</sup> )<br>0.62<br>0.62<br>0.62<br>0.62<br>F <sub>w,v</sub> = <b>-7.76</b> kN | External           size factor,           Cae           1.000           1.000           1.000           1.000 | Net<br>Pressu<br>p (kN/<br>-0.6<br>-0.3<br>-0.8<br>-0.5 | t<br>met ford<br>t<br>m <sup>2</sup> )<br>5<br>8<br>6<br>3          | 20 F<br>Are<br>A <sub>ref</sub> (<br>0.4<br>8.7<br>0.4<br>8.7 | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )<br>44<br>72<br>44   | Net force,<br>F <sub>w</sub> (kN)<br>-0.29<br>-3.31<br>-0.38<br>-4.58 |
| Total vertica<br>Roof load c<br>Zone<br>A (-ve)<br>C (-ve)<br>E (-ve)<br>G (-ve)<br>Total vertica | ase 2 - Wind 0, c <sub>pi</sub><br>Ext<br>pressure<br>coefficient,<br>c <sub>pe</sub><br>-0.70<br>-0.27<br>-1.03<br>-0.50<br>net force | F <sub>w,v</sub> = <b>4.65</b> kN<br><b>0.40, - c</b> <sub>pe</sub><br>Dynamic<br>pressure, q₅<br>(kN/m <sup>2</sup> )<br>0.62<br>0.62<br>0.62<br>0.62<br>F <sub>w,v</sub> = <b>-7.76</b> kN | External           size factor,           Cae           1.000           1.000           1.000           1.000 | Net<br>Pressu<br>p (kN/<br>-0.6<br>-0.3<br>-0.8<br>-0.5 | t ure, m <sup>2</sup> )<br>5<br>8<br>6<br>3<br>1 net foro<br>t ure, | 20 F<br>Are<br>A <sub>ref</sub> (<br>0.4<br>8.7<br>0.4<br>8.7 | F <sub>w,h</sub> = <b>2</b> .<br>ea,<br>m <sup>2</sup> )<br>44<br>72<br>44<br>72<br>F <sub>w,h</sub> = <b>0</b> .<br>ea, | Net force,<br>F <sub>w</sub> (kN)<br>-0.29<br>-3.31<br>-0.38<br>-4.58 |

1.000-1.153.801.000-1.093.801.000-0.7010.71

Total vertical net force  $F_{w,v} = -14.48 \text{ kN}$ 

-1.23

-0.60

0.62

0.62

B (-ve)

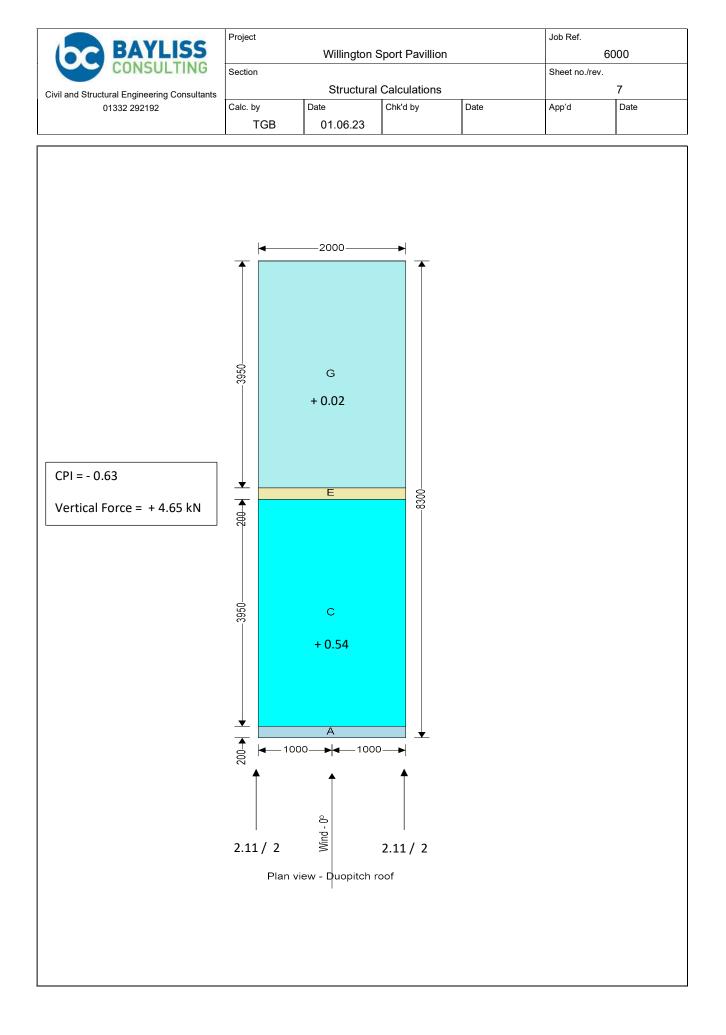
C (-ve)

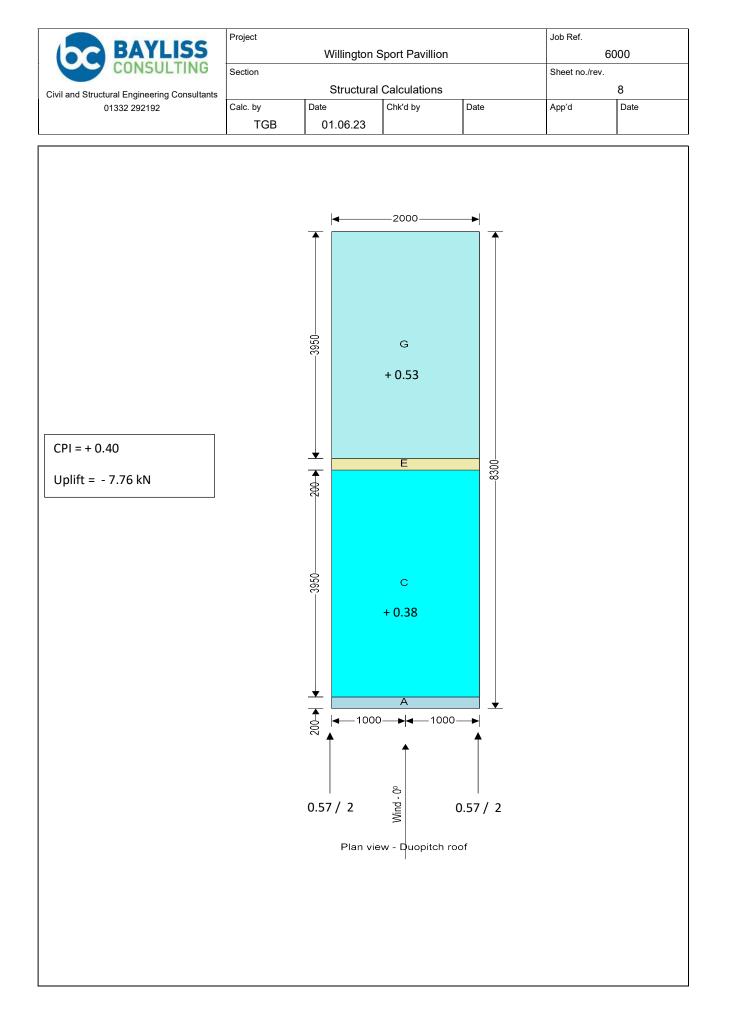
Total horizontal net force

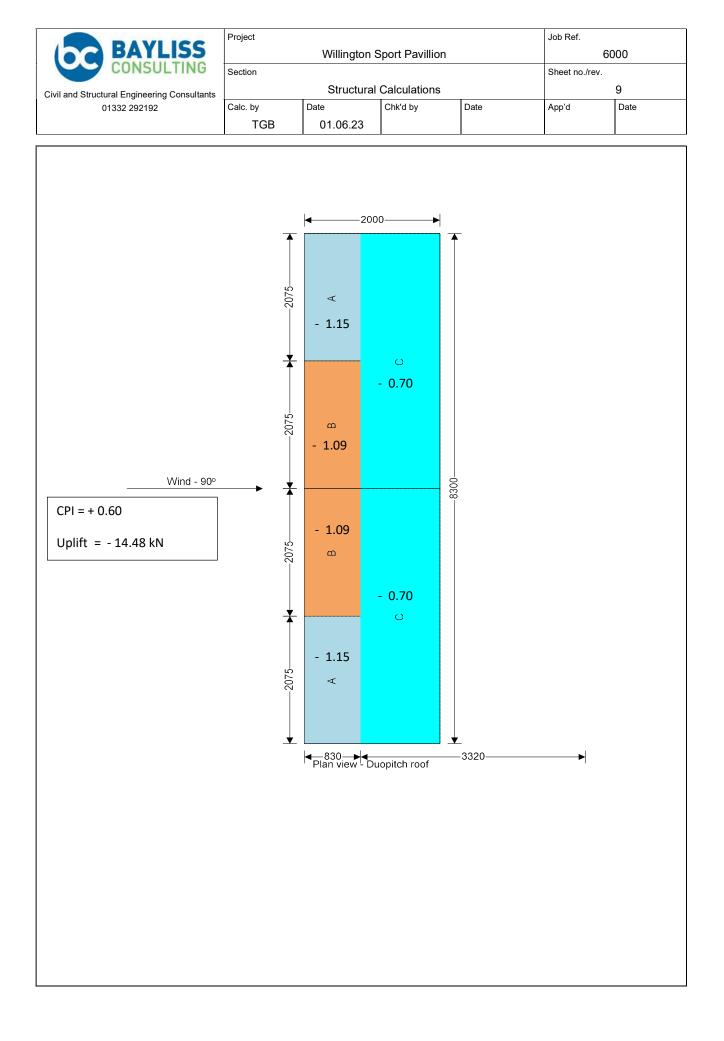
F<sub>w,h</sub> = **0.00** kN

-4.15

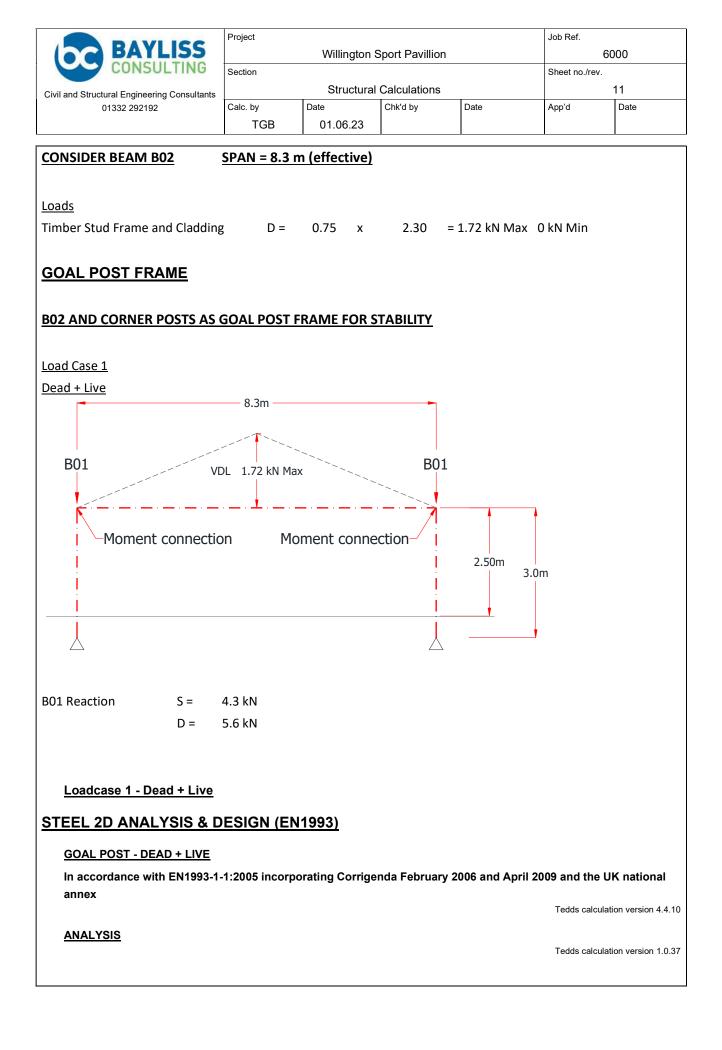
-7.45





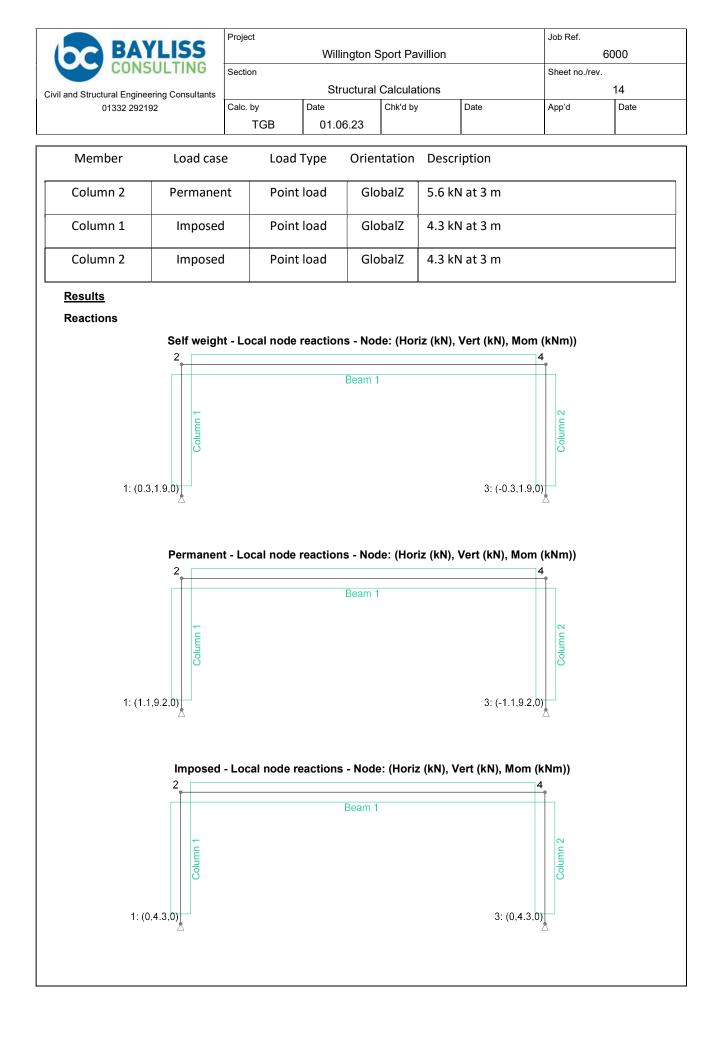


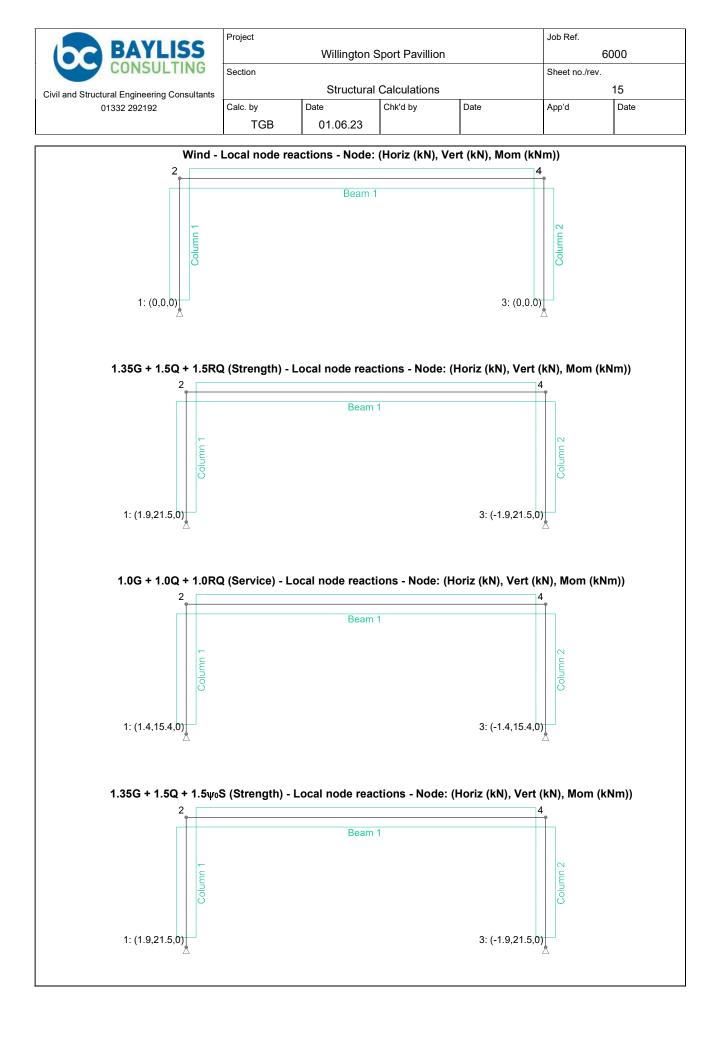
| 6                     | BAYL                       |                         | Project       |                    | Wi                       | llington Sp | oort Pavill | ion  |                 | Job Ref.    | 6000 |
|-----------------------|----------------------------|-------------------------|---------------|--------------------|--------------------------|-------------|-------------|------|-----------------|-------------|------|
|                       | CONSU                      | LTING                   | Section       |                    | _                        |             |             |      |                 | Sheet no./r |      |
| Civil and St          | ructural Engineering       | g Consultants           |               |                    |                          | tructural C |             |      |                 | A           | 10   |
|                       | 01332 292192               |                         | Calc. by<br>T | '<br>GB            | Date<br>01               | 06.23       | Chk'd by    | Date | 8               | App'd       | Date |
|                       |                            |                         |               |                    | I                        |             |             |      |                 |             |      |
|                       | ER BEAM BO                 | <u>01</u>               | <u>SPAN</u>   | = 2.0 ı            | m (effe                  | ective)     |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| <u>Loads</u>          |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| Roof                  | S =                        | 0.75                    | х             | 2.0                | х                        | 4.3         | х           | 1.6  | = 10.32 k       | N           |      |
|                       | D =                        | 0.80                    | х             | 2.0                | х                        | 4.8         | х           | 1.4  | = 10.75 k       | N           |      |
| Ceiling               | S =                        | 0.25                    | х             | 2.0                | х                        | 4.3         | х           | 1.6  | = 3.44 k        | N           |      |
|                       | D =                        | 0.35                    | х             | 2.0                | х                        | 4.3         | х           | 1.4  | = 4.21 k        | N           |      |
| Swt                   | D =                        | 0.30                    | x             | 2.0                | х                        | 1.4         |             |      | <u>= 0.84 k</u> | <u>N</u>    |      |
|                       |                            |                         |               |                    |                          |             |             |      | = 29.56 k       | N           |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| eł 1.2                | L + 2D                     |                         | =             | 2.70               | m                        |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| V = 2                 | 29.56 / 2                  |                         | =             | 14.78              | 8 kN                     |             |             |      |                 |             |      |
|                       | 23.3072                    |                         |               | 14.70              |                          |             |             |      |                 |             |      |
| M = 2                 | 29.56 x 2.0 / 8            | 2                       | =             | <u>7.39</u>        | kNm                      |             |             |      |                 |             |      |
|                       | 29.30 x 2.0 / 0            | )                       | -             | 1.55               | KINIII                   |             |             |      |                 |             |      |
| δim = 2               | 2000 / 360                 |                         | _             |                    |                          |             |             |      |                 |             |      |
|                       | 2000/300                   |                         | =             | 5.5 m              | 1111                     |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            | <b>.</b>                |               |                    |                          |             |             |      |                 |             |      |
| I <sub>rea</sub> 'd = | 5 × 20.30 × 2<br>384 × 2.1 | $2.0^{3} \times 10^{3}$ | = 183         | s cm <sup>4</sup>  |                          |             |             |      |                 |             |      |
| ieq u                 | 384 × 2.1                  | × 5.5                   |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| _                     |                            |                         | _             |                    |                          |             |             |      |                 |             |      |
| <u>PROVI</u>          | DE 150 x 9                 | <u>0 x 24 k</u>         | g PFC         | <u>S355</u>        |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
| Mb @ 2.               | 70 m                       | =                       |               |                    | <u>.39 kNi</u>           |             |             |      |                 |             |      |
| l <sub>prov'd</sub>   |                            | =                       | <u>1160 c</u> | : <u>m⁴ &gt; 1</u> | <u>83 cm<sup>4</sup></u> |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |
|                       |                            |                         |               |                    |                          |             |             |      |                 |             |      |



| bc              | BAY                          |         | Project |         | Willingto           | n Sport Pa   | avillio      | n    |                | Job Re            | 6000        |         |
|-----------------|------------------------------|---------|---------|---------|---------------------|--------------|--------------|------|----------------|-------------------|-------------|---------|
|                 | 00110                        | CLINIC  |         |         | Structu             | ral Calcula  | ations       |      |                | Sheet r           | 12 io./rev. |         |
| Civil and Struc | tural Enginee<br>01332 29219 | -       | Calc. b | /<br>GB | Date 01.06.23       | Chk'd b      |              |      | Date           | App'd             | Da          | ite     |
| Geome           |                              |         |         |         |                     |              |              |      |                |                   |             |         |
| Materia         |                              |         |         |         |                     |              |              |      |                |                   |             |         |
| Nai             |                              | Den     | sity    | Youn    | gs Modulus          | Shear N      | Modu         | ulus |                | ermal<br>fficient |             |         |
|                 |                              | (kg/    | m³)     | kl      | N/mm²               | kN/          | mm²          | 2    |                | °C-1              |             |         |
| Steel           | (EC3)                        | 78      | 50      |         | 210                 | 80           | 0.8          |      | 0.0            | 00012             |             |         |
| Sectio          | ns                           |         |         |         |                     |              |              |      |                |                   |             |         |
| Nai             | me                           | Area    | M       | oment   | of inertia          | Shear a      | area j       | para | llel to        |                   |             |         |
|                 |                              |         | Ma      | ajor    | Minor               | Minor        | r            | Μ    | lajor          |                   |             |         |
|                 |                              | (cm²)   | (cı     | m⁴)     | (cm <sup>4</sup> )  | (cm²)        |              | (c   | cm²)           |                   |             |         |
| Colum<br>152x1  |                              | 29.2    | 124     | 19.8    | 399.9               | 8.8          |              | 1    | .8.6           |                   |             |         |
| Beam<br>254x1   |                              | 39.7    | 441     | 13.4    | 447.5               | 15.1         |              | 2    | 2.6            |                   |             |         |
| Nodes           |                              |         |         |         |                     |              |              |      |                |                   |             |         |
| Node            | Co-ord                       | linates |         | Freedo  | m                   | Coord<br>sys | dinat<br>tem | e    |                | Spring            |             |         |
|                 | х                            | Z       | Х       | Z       | Rot.                | Name         | An           | ngle | Х              | Z                 | Rot.        |         |
|                 | (m)                          | (m)     |         |         |                     |              | (            | °)   | (kN/m)         | (kN/m)            | kNm/°       |         |
| 1               | 0                            | 0       | Fixed   | Fixed   | Free                |              |              | 0    | 0              | 0                 | 0           |         |
| 2               | 0                            | 3       | Free    | Free    | Free                |              |              | 0    | 0              | 0                 | 0           |         |
| 3               | 8.3                          | 0       | Fixed   | Fixed   | Free                |              |              | 0    | 0              | 0                 | 0           |         |
| 4               | 8.3                          | 3       | Free    | Free    | Free                |              |              | 0    | 0              | 0                 | 0           | ]       |
| Eleme           |                              |         |         |         |                     |              |              |      |                |                   |             |         |
| Element         | Length                       | No      | odes    | S       | ection              | Mat          | erial        |      |                | Releases          |             | Rotated |
|                 | (m)                          | Start   | End     |         |                     |              |              |      | Start<br>momen | End<br>t moment   | Axial       |         |
| 1               | 3                            | 1       | 2       |         | ımn - UC<br>x152x23 | Steel        | (EC3         | 3)   | Fixed          | Fixed             | Fixed       |         |
|                 |                              |         |         |         |                     |              |              |      |                |                   |             |         |

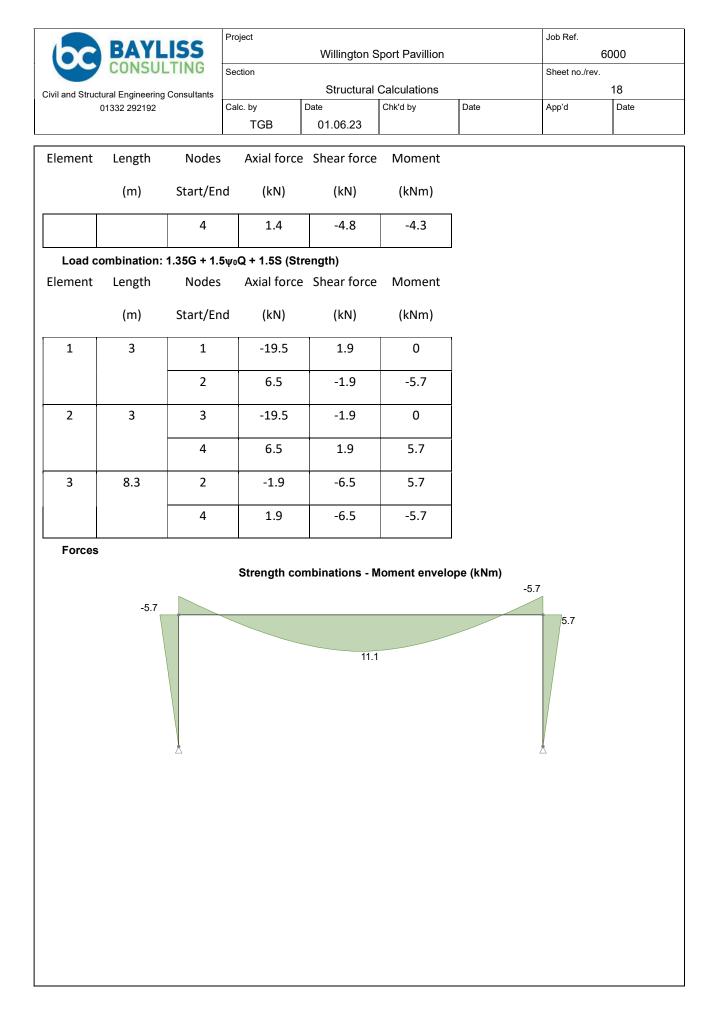
| 60                  | BAY                           |                       | Project  |          | Willir                | ngton S   | port Pa             | villion |                 | Job Ref       | 600       | 0       |
|---------------------|-------------------------------|-----------------------|----------|----------|-----------------------|-----------|---------------------|---------|-----------------|---------------|-----------|---------|
|                     | ural Engineer<br>01332 29219: | ring Consultants<br>2 | Calc. by | GB       | Stru<br>Date<br>01.06 |           | Calcula<br>Chk'd by |         | Date            | App'd         | 13        | ate     |
| Element             | Length                        | Node                  | es       | Sec      | tion                  |           | Mate                | erial   |                 | Releases      | I         | Rotateo |
|                     | (m)                           | Start                 | End      |          |                       |           |                     |         | Start<br>moment | End<br>moment | Axial     |         |
| 2                   | 3                             | 3                     | 4        |          | in - UC<br>52x23      |           | Steel               | (EC3)   | Fixed           | Fixed         | Fixed     |         |
| 3                   | 8.3                           | 2                     | 4        |          | n - UB<br>46x31       |           | Steel               | (EC3)   | Fixed           | Fixed         | Fixed     |         |
| Membe               | rs                            |                       |          |          |                       |           |                     |         |                 |               |           |         |
| Nan                 | ne                            |                       | Elem     | ents     |                       |           |                     |         |                 |               |           |         |
|                     |                               | Start                 |          | E        | nd                    |           |                     |         |                 |               |           |         |
| Column 1            |                               | 1                     |          |          | 1                     |           |                     |         |                 |               |           |         |
| Column 2            |                               | 2                     |          |          | 2                     |           |                     |         |                 |               |           |         |
| Beam 1              |                               | 3                     |          |          | 3                     |           |                     |         |                 |               |           |         |
| Loading<br>Self wei | -                             | ed (Self weigh        | nt x 1)  |          |                       |           |                     |         |                 |               |           |         |
| Load co             | ombinatio                     | n factors             |          |          |                       |           |                     |         |                 |               |           |         |
|                     | Load                          | combinatio            | 'n       |          | Self weight           | Permanent | Imposed             | Wind    |                 |               |           |         |
| 1.35G + 1.          | 5Q + 1.5F                     | RQ (Strength          | 1)       |          | 1.35                  | 1.35      | 1.50                |         |                 |               |           |         |
| 1.0G + 1.0          | Q + 1.0R0                     | Q (Service)           |          |          | 1.00                  | 1.00      | 1.00                |         |                 |               |           |         |
| 1.35G + 1.          | 5Q + 1.5ι                     | µ₀S (Strengt          | h)       |          | 1.35                  | 1.35      | 1.50                |         |                 |               |           |         |
| 1.0G + 1.0          | Q + 0.5S                      | (Service)             |          |          | 1.00                  | 1.00      | 1.00                |         |                 |               |           |         |
| 1.35G + 1.          | 5ψ₀Q + 1                      | .5S (Strengt          | h)       |          | 1.35                  | 1.35      | 1.05                |         |                 |               |           |         |
| Membe               | r Loads                       |                       |          |          |                       |           |                     |         |                 |               |           |         |
| Mem                 | ber                           | Load cas              | е        | Load Ty  | /pe                   | Orien     | tation              | Desc    | ription         |               |           |         |
| Bean                | n 1                           | Permane               | nt       | VDL      |                       | Glo       | balZ                | 0 kN/   | /m at 0 m to    | 1.72 kN/n     | n at 4.15 | i m     |
| Bean                | n 1                           | Permane               | nt       | VDL      |                       | Glo       | balZ                | 1.72    | kN/m at 4.1     | 5 m to 0 kl   | N/m at 8  | 8.3 m   |
| Colun               | nn 1                          | Permane               | nt       | Point lo | bad                   | Glo       | balZ                | 5.6 k   | N at 3 m        |               |           |         |

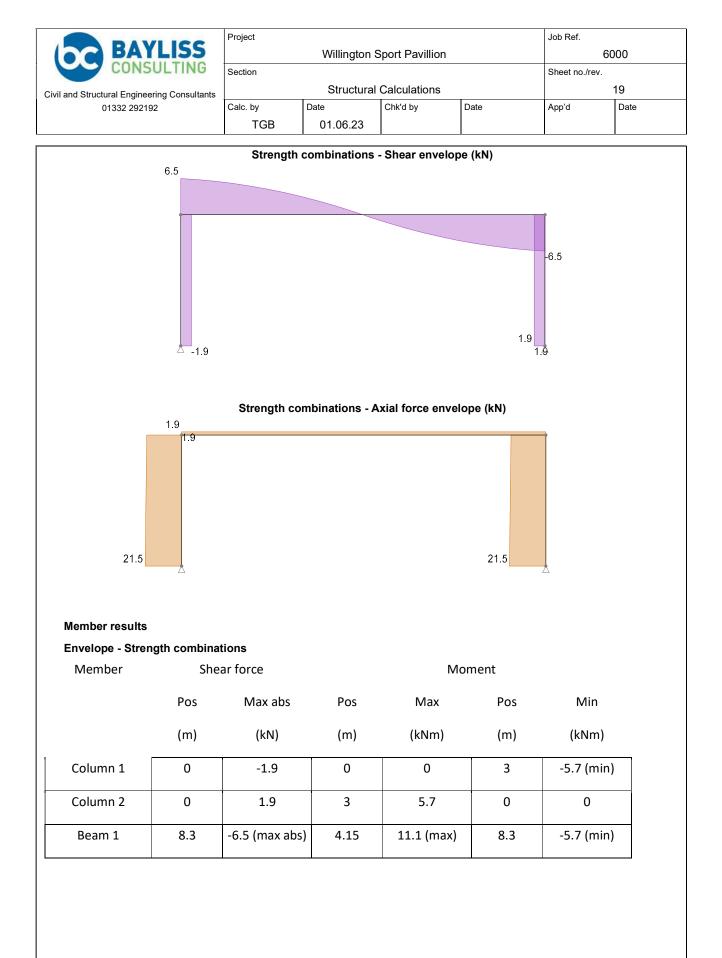




|                  | <b>BAYL</b><br>CONSUL                               | TIMO   | ction  | winngton c                                 | port Pavillion          |                | Sheet no./re    | 6000   |
|------------------|---|--|--|--|-------------------------|----------------|-----------------|--------|
| Land Struct      | ural Engineering                                    |  |  | Structural                                 | Calculations            |                |                 | 16     |
|                  | 01332 292192  |  | Ic. by I<br>TGB                              | Date<br>01.06.23                           | Chk'd by                | Date           | App'd           | Date   |
|                  | 1.0G + 1  | .0Q + 0.5S (Se   | ervice) - Loca                               | l node reactio                             | ons - Node: (He         | oriz (kN), Vei | rt (kN), Mom (k | Nm))   |
|                  | 1: (1.4,15.   | 4,0)   |  | Beam 1                                     | I                       | 3: (-1.4,1     | 5.4,0)          |        |
|                  | 1.35G + 1.5   | 5ψ₀Q + 1.5S (S   | Strength) - Lo                               | cal node reac                              |                         | (Horiz (kN), V | /ert (kN), Mom  | (kNm)) |
|                  |   |  |  |  |                         |                |                 |        |
|                  | 1: (1.9,19.   | 5,0)   |  |  |                         | 3: (-1.9,1     | 9.5,0)          |        |
|                  |   | 5,0)   |  |  |                         | 3: (-1.9,1     | Column          |        |
|                  | t end forces  | 5,0)   |  |  |                         | 3: (-1.9,1     | Column          |        |
| Load co          | t end forces  | 5,0)<br>Å  |  |  | Moment                  | 3: (-1.9,1     | Column          |        |
| Load co          | t end forces  | 5,0)   |  | e <b>ngth)</b><br>Shear force<br>(kN)      | Moment<br>(kNm)         | 3: (-1.9,1     | Column          |        |
| Load co          | it end forces<br>ombination:<br>Length              | 5,0)<br>5,0)<br>1.35G + 1.5Q<br>Nodes                            | Axial force                                  | Shear force                                |                         | 3: (-1.9,1     | Column          |        |
| Load co          | nt end forces<br>combination:<br>Length<br>(m)      | 5,0)<br><b>1.35G + 1.5Q</b><br>Nodes<br>Start/End                | Axial force<br>(kN)                          | Shear force<br>(kN)                        | (kNm)                   | 3: (-1.9,1     | Column          |        |
| Load co          | nt end forces<br>combination:<br>Length<br>(m)      | 5,0)<br><b>1.35G + 1.5Q</b><br>Nodes<br>Start/End<br>1           | Axial force<br>(kN)<br>-21.5                 | Shear force<br>(kN)<br>1.9                 | (kNm)<br>0              | 3: (-1.9,1     | Column          |        |
| Load co<br>ement | nt end forces<br>combination:<br>Length<br>(m)<br>3 | 5,0)<br><b>1.35G + 1.5Q</b><br>Nodes<br>Start/End<br>1<br>2      | Axial force<br>(kN)<br>-21.5<br>6.5          | Shear force<br>(kN)<br>1.9<br>-1.9         | (kNm)<br>0<br>-5.7      | 3: (-1.9,1     | Column          |        |
| Load co<br>ement | nt end forces<br>combination:<br>Length<br>(m)<br>3 | 5,0)<br><b>1.35G + 1.5Q</b><br>Nodes<br>Start/End<br>1<br>2<br>3 | Axial force<br>(kN)<br>-21.5<br>6.5<br>-21.5 | Shear force<br>(kN)<br>1.9<br>-1.9<br>-1.9 | (kNm)<br>0<br>-5.7<br>0 | 3: (-1.9,1     | Column          |        |

|         | BAYL                             | ISS         | Project          | Willington S  | port Pavillion           |      | Job Ref.      | 6000       |
|---------|----------------------------------|-------------|------------------|---------------|--------------------------|------|---------------|------------|
|         | CONSUL                           | TING        | Section          |               |                          |      | Sheet no./rev |            |
|         | ural Engineering<br>01332 292192 | Consultants | Calc. by         | Structural    | Calculations<br>Chk'd by | Date | App'd         | 17<br>Date |
| ,       | 01332 292192                     |             | TGB              | 01.06.23      | Onica by                 | Date | Abb a         | Date       |
|         |                                  |             |                  |               |                          |      |               |            |
| Load co |                                  | 1.0G + 1.00 | Q + 1.0RQ (Serv  | -             |                          |      |               |            |
| Element | Length                           | Nodes       | Axial force      | e Shear force | Moment                   |      |               |            |
|         | (m)                              | Start/En    | d (kN)           | (kN)          | (kNm)                    |      |               |            |
| 1       | 3                                | 1           | -15.4            | 1.4           | 0                        |      |               |            |
|         |                                  | 2           | 4.8              | -1.4          | -4.3                     |      |               |            |
| 2       | 3                                | 3           | -15.4            | -1.4          | 0                        |      |               |            |
|         |                                  | 4           | 4.8              | 1.4           | 4.3                      |      |               |            |
| 3       | 8.3                              | 2           | -1.4             | -4.8          | 4.3                      |      |               |            |
|         |                                  | 4           | 1.4              | -4.8          | -4.3                     |      |               |            |
| Load co | ombination:                      | 1.35G + 1.5 | iQ + 1.5ψ₀S (St  | rength)       |                          | I    |               |            |
| Element | Length                           | Nodes       |                  | e Shear force | Moment                   |      |               |            |
|         | (m)                              | Start/En    | d (kN)           | (kN)          | (kNm)                    |      |               |            |
| 1       | 3                                | 1           | -21.5            | 1.9           | 0                        |      |               |            |
|         |                                  | 2           | 6.5              | -1.9          | -5.7                     |      |               |            |
| 2       | 3                                | 3           | -21.5            | -1.9          | 0                        |      |               |            |
|         |                                  | 4           | 6.5              | 1.9           | 5.7                      |      |               |            |
| 3       | 8.3                              | 2           | -1.9             | -6.5          | 5.7                      |      |               |            |
|         |                                  | 4           | 1.9              | -6.5          | -5.7                     |      |               |            |
| Load co | ombination:                      | 1.0G + 1.00 | Q + 0.5S (Servio | ce)           |                          |      |               |            |
| Element | Length                           | Nodes       | Axial force      | e Shear force | Moment                   |      |               |            |
|         | (m)                              | Start/En    | d (kN)           | (kN)          | (kNm)                    |      |               |            |
| 1       | 3                                | 1           | -15.4            | 1.4           | 0                        |      |               |            |
|         |                                  | 2           | 4.8              | -1.4          | -4.3                     |      |               |            |
| 2       | 3                                | 3           | -15.4            | -1.4          | 0                        |      |               |            |
|         |                                  | 4           | 4.8              | 1.4           | 4.3                      |      |               |            |
| 3       | 8.3                              | 2           | -1.4             | -4.8          | 4.3                      |      |               |            |





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| Civil and Structural Engineering Consultants | Structural Calculations |              |                |      | 20    |      |
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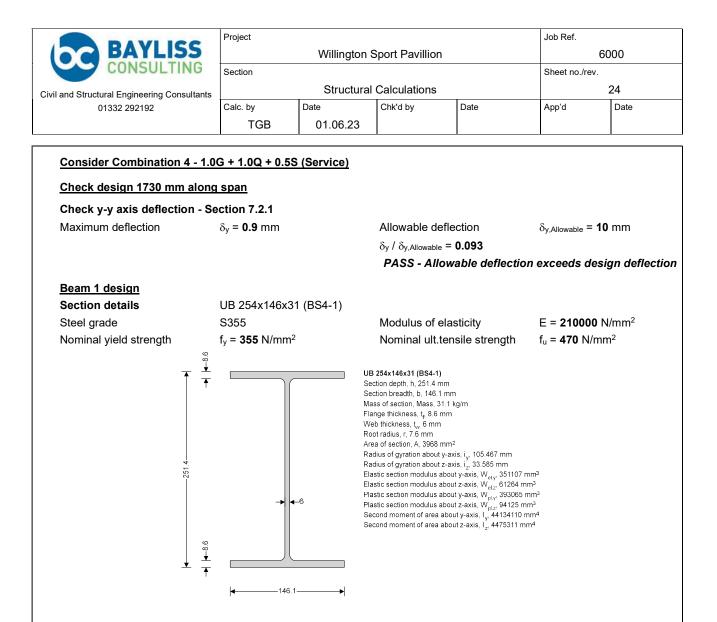
| Envelope - Strer   | ath combine  | tions  |         |  |   |   |
|--|--------------|--|---------|--|---|---|
| Member   |              |  | l force |  |   |   |
| Member   |              | Axia   | TIOICE  |  |   |   |
|  | Pos          | Max  | Pos     | Min  |   |   |
|  | (m)          | (kN)   | (m)     | (kN)   |   |   |
| Column 1   | 0            | 21.5 (max)   | 3       | 0 (min)  |   |   |
| Column 2   | 0            | 21.5 (max)   | 3       | 0 (min)  |   |   |
| Beam 1   | 0            | 1.9  | 0       | 1.9  |   |   |
| Envelope - Servi   | ice combinat | ions   |         |  |   |   |
| Member   |              | Defle  | ction   |  |   |   |
|  | Pos          | Max  | Pos     | Min  |   |   |
|  | (m)          | (mm)   | (m)     | (mm)   |   |   |
| Column 1   | 3            | 0  | 1.73    | -0.9 (min)   |   |   |
| Column 2   | 1.73         | 0.9  | 3       | 0  |   |   |
| Beam 1   | 4.15         | 5.6 (max)  | 0       | 0.1  |   |   |
| Partial factors -  | Section 6.1  | γ <sub>M0</sub> = <b>1</b>                                 |         | γ <sub>M1</sub> = <b>1</b>   |   | γ <sub>M2</sub> = <b>1.1</b>  |
| <u>Column 1 design</u><br>Section details<br>Steel grade<br>Nominal yield stre |              | UC 152x152x23<br>S355<br>fy <b>= 355</b> N/mm <sup>2</sup> | (BS4-1) | Modulus of elas  |   | E = <b>210000</b> N/mm²<br>f <sub>u</sub> = <b>470</b> N/mm²  |
| 7<br>803<br>1  |              |  | 5.8     | Radius of gyratic<br>Elastic section m<br>Elastic section m<br>Plastic section m<br>Plastic section m<br>Second moment | , 152.4 mm<br>b, 152.2 mm<br>Mass, 23 kg/m<br>s, t <sub>ρ</sub> 6.8 mm<br>t <sub>v</sub> , 5.8 mm<br>6 mm | 79 mm<br>v <sub>et,x</sub> 164016 mm <sup>3</sup><br>v <sub>et,x</sub> 52552 mm <sup>3</sup><br>v <sub>p1,y</sub> 181982 mm <sup>3</sup><br>v <sub>p1,x</sub> 80156 mm <sup>3</sup><br>r 12498039 mm <sup>4</sup> |

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| Column 1 results summar   | У  | Unit  | Capacity  | Maximum   | Utilisation  | Result   |
|---|--|---|---|---|--|--|
| Shear resistance (y-y)  |  | kN  | 204.4   | 1.9   | 0.009  | PASS   |
| Bending resistance (y-y)  |  | kNm   | 58.2  | 5.7   | 0.099  | PASS   |
| Compression resistance  |  | kN  | 524.3   | 21.5  | 0.041  | PASS   |
| Comb. bending and axial   | force  |   |   |   | 0.147  | PASS   |
| Deflection (y-y)  |  | mm  | 10  | 0.9   | 0.093  | PASS   |
| <b>Lateral restraint</b><br>Both flanges have lateral rest  | raint at supports  | only  |   |   |  |  |
| Classification of cross sect  |  | -   |   |   |  |  |
| Internal compression parts  | Class 1  |   | Outstand  | flanges   | Class 3  |  |
| ····· ··· · · · · · · · · · · · · · ·   |  |   |   |   | Sect   | ion is clas  |
| Check compression - Section   | on 6.2.4   |   |   |   |  |  |
| Design compression force $N_{Ed} = 21.5 \text{ kN}$   |  |   | 0   | esistance of section  | N <sub>c,Rd</sub> = N <sub>pl,Rd</sub> =   | = <b>1038.2</b> kN                                   |
|   |  | PΔS   |   | a – 0.021<br>ession resistance e  | exceeds design   | compressi  |
| Check y-y axis flexural bucl  | kling registeres   |   |   |   |  |  |
| Gheck v-v axis hexural duci   | kiinu resistance   | : - Secu  | 011 0.3.1.1   |   |  |  |
|   | -  |   |   | Pd = 0 025  |  |  |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7  |   | N <sub>Ed</sub> / N <sub>b,y</sub>  | <sub>,Rd</sub> = 0.025<br>ckling resistance e   | exceeds design (   | compressi  |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7  | <b>/</b> kN   | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu  | <sub>,Rd</sub> = 0.025<br>ckling resistance e   | exceeds design (   | compressi  |
| Design buckling resistance<br>Check z-z axis flexural buck  | N <sub>b,y,Rd</sub> = 868.7  | ' kN<br>- Secti   | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1  | ckling resistance e   | exceeds design (   | compressi  |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7  | ' kN<br>- Secti   | N <sub>Ed</sub> / N <sub>b,y</sub><br><i>PASS - Design bu</i><br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub>   | ckling resistance e   | -  | -  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>N <sub>b,z,Rd</sub> = 524.3   | ' kN<br>- <b>Secti</b><br>3 kN                              | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub><br>PASS - Design bu  | ckling resistance e<br><sub>.Rd</sub> = 0.041<br>ckling resistance e  | -  | -  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior   | N <sub>b,y,Rd</sub> = 868.7<br>Kling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>nal-flexural buck  | / kN<br>- Secti<br>3 kN<br>kling re                         | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub><br>PASS - Design bu<br>sistance - Section  | ckling resistance e<br><sub>.Rd</sub> = 0.041<br>ckling resistance e<br>6.3.1.1   | -  | -  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>N <sub>b,z,Rd</sub> = 524.3   | / kN<br>- Secti<br>3 kN<br>kling re                         | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub><br>PASS - Design bu<br>sistance - Section<br>N <sub>Ed</sub> / N <sub>b,T</sub>  | rckling resistance e<br><sub>Rd</sub> = 0.041<br>rckling resistance e<br>6.3.1.1<br><sub>Rd</sub> = 0.032   | exceeds design (   | compressi  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance   | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>$N_{b,z,Rd}$ = 524.3<br>hal-flexural buck<br>$N_{b,T,Rd}$ = 671.6   | / kN<br>- Secti<br>3 kN<br>kling re                         | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub><br>PASS - Design bu<br>sistance - Section<br>N <sub>Ed</sub> / N <sub>b,T</sub>  | ckling resistance e<br><sub>.Rd</sub> = 0.041<br>ckling resistance e<br>6.3.1.1   | exceeds design (   | compressi  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa   | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>$N_{b,z,Rd}$ = 524.3<br>hal-flexural buck<br>$N_{b,T,Rd}$ = 671.6   | / kN<br>- Secti<br>3 kN<br>kling re                         | N <sub>Ed</sub> / N <sub>b,y</sub><br>PASS - Design bu<br>on 6.3.1.1<br>N <sub>Ed</sub> / N <sub>b,z</sub><br>PASS - Design bu<br>sistance - Section<br>N <sub>Ed</sub> / N <sub>b,T</sub>  | ckling resistance e<br><sub>Rd</sub> = 0.041<br>ckling resistance e<br>6.3.1.1<br><sub>Rd</sub> = 0.032   | exceeds design (   | compressi  |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa<br>Check shear - Section 6.2.6  | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>hal-flexural buck<br>N <sub>b,T,Rd</sub> = 671.8<br><u>n</u>   | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN                  | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu  | ckling resistance e<br><sub>Rd</sub> = 0.041<br>ckling resistance e<br>6.3.1.1<br><sub>Rd</sub> = 0.032<br>ckling resistance e  | exceeds design o   | compressi<br>compressi                               |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa   | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>$N_{b,z,Rd}$ = 524.3<br>hal-flexural buck<br>$N_{b,T,Rd}$ = 671.6   | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN                  | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design s  | rckling resistance e<br>Rd = 0.041<br>rckling resistance e<br>6.3.1.1<br>Rd = 0.032<br>rckling resistance e<br>hear resistance  | exceeds design (   | compressi<br>compressi                               |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa<br>Check shear - Section 6.2.6  | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>hal-flexural buck<br>N <sub>b,T,Rd</sub> = 671.8<br><u>n</u>   | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN                  | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design si<br>Vy,Ed / Vpl  | hear resistance e   | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | compressi<br>compressi<br>4 kN                       |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa<br>Check shear - Section 6.2.6<br>Design shear force  | N <sub>b,y,Rd</sub> = 868.7<br>Kling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>hal-flexural buck<br>N <sub>b,T,Rd</sub> = 671.8<br>$\underline{n}$<br>V <sub>y,Ed</sub> = 1.9 kN                            | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN                  | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design si<br>Vy,Ed / Vpl  | rckling resistance e<br>Rd = 0.041<br>rckling resistance e<br>6.3.1.1<br>Rd = 0.032<br>rckling resistance e<br>hear resistance  | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | compressi<br>compressi<br>4 kN                       |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsior<br>Design buckling resistance<br>Check design at end of spa<br>Check shear - Section 6.2.6  | N <sub>b,y,Rd</sub> = 868.7<br>Kling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>hal-flexural buck<br>N <sub>b,T,Rd</sub> = 671.8<br>$\underline{n}$<br>V <sub>y,Ed</sub> = 1.9 kN                            | ' kN<br>- Secti<br>3 kN<br>(ling re<br>3 kN                 | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design si<br>Vy,Ed / Vp<br>PASS - Desig<br>Bending  | ckling resistance e<br>$_{Rd} = 0.041$<br>ckling resistance e<br>6.3.1.1<br>$_{Rd} = 0.032$<br>ckling resistance e<br>hear resistance<br>$_{Ly,Rd} = 0.009$<br>gn shear resistance<br>resistance moment                       | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | compressi<br>compressi<br>4 kN<br>n shear for        |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsion<br>Design buckling resistance<br><u>Check design at end of spa</u><br><u>Check shear - Section 6.2.6</u><br>Design shear force<br>Check bending moment - S                          | N <sub>b,y,Rd</sub> = 868.7<br>(ling resistance<br>N <sub>b,z,Rd</sub> = 524.3<br>hal-flexural buck<br>N <sub>b,T,Rd</sub> = 671.8<br>N <sub>y,Ed</sub> = 1.9 kN<br>ection 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kN | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN                  | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design st<br>Vy,Ed / Vpl<br>PASS - Desig<br>Bending<br>My,Ed / Ma                                     | ckling resistance e<br>$_{Rd}$ = 0.041<br>ckling resistance e<br>6.3.1.1<br>$_{Rd}$ = 0.032<br>ckling resistance e<br>hear resistance<br>$_{Ly,Rd}$ = 0.009<br>gn shear resistance<br>resistance moment<br>$_{Ly,Rd}$ = 0.099 | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>M <sub>c,y,Rd</sub> = 58.2 | compressi<br>compressi<br>4 kN<br>n shear for<br>kNm |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsion<br>Design buckling resistance<br><u>Check design at end of spa</u><br><u>Check shear - Section 6.2.6</u><br>Design shear force<br>Check bending moment - S<br>Design bending moment | Nb,y,Rd = 868.7<br>Kling resistance<br>Nb,z,Rd = 524.3<br>hal-flexural buck<br>Nb,T,Rd = 671.8<br>N<br>Vy,Ed = 1.9 kN<br>ection 6.2.5<br>My,Ed = 5.7 kN<br>PAS.  | Y kN<br>- Secti<br>3 kN<br>ding re<br>3 kN<br>Im<br>S - Des | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design st<br>Vy,Ed / Vpl<br>PASS - Desig<br>Bending<br>My,Ed / Ma                                     | ckling resistance e<br>$_{Rd} = 0.041$<br>ckling resistance e<br>6.3.1.1<br>$_{Rd} = 0.032$<br>ckling resistance e<br>hear resistance<br>$_{Ly,Rd} = 0.009$<br>gn shear resistance<br>resistance moment                       | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>M <sub>c,y,Rd</sub> = 58.2 | compressi<br>compressi<br>4 kN<br>n shear for<br>kNm |
| Design buckling resistance<br>Check z-z axis flexural buck<br>Design buckling resistance<br>Check torsional and torsion<br>Design buckling resistance<br><u>Check design at end of spa</u><br><u>Check shear - Section 6.2.6</u><br>Design shear force<br>Check bending moment - S                          | Nb,y,Rd = 868.7<br>Kling resistance<br>Nb,z,Rd = 524.3<br>hal-flexural buck<br>Nb,T,Rd = 671.8<br>N<br>Vy,Ed = 1.9 kN<br>ection 6.2.5<br>My,Ed = 5.7 kN<br>PAS.  | r kN<br>- Secti<br>3 kN<br>ding re<br>3 kN<br>lm<br>S - Des | NEd / Nb,y<br>PASS - Design bu<br>on 6.3.1.1<br>NEd / Nb,z<br>PASS - Design bu<br>sistance - Section<br>NEd / Nb,T<br>PASS - Design bu<br>Design st<br>Vy,Ed / Vpi<br>PASS - Desig<br>Bending<br>My,Ed / Ma<br>ign bending resist | ckling resistance e<br>$_{Rd}$ = 0.041<br>ckling resistance e<br>6.3.1.1<br>$_{Rd}$ = 0.032<br>ckling resistance e<br>hear resistance<br>$_{Ly,Rd}$ = 0.009<br>gn shear resistance<br>resistance moment<br>$_{Ly,Rd}$ = 0.099 | exceeds design o<br>exceeds design o<br>V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>M <sub>c,y,Rd</sub> = 58.2 | compressi<br>compressi<br>kNn<br>shear for           |

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|--|--|------------|------------------------------------|-------------------------------|--|---|-------------------|
| CONSULTING   | Section  |            |                                    |                               |  | Sheet no./rev.                                  |                   |
| I and Structural Engineering Consultants   |  | . 5        | Structural                         | Calculation                   | s  |   | 22                |
| 01332 292192   | Calc. by<br>TGB  | Date<br>01 | .06.23                             | Chk'd by                      | Date   | App'd   | Date              |
|  | IGB  | 01         | .00.23                             |                               |  |   |                   |
| Check bending and axial for  | ce - Section 6.2.9                                     | 9          |                                    |                               |  |   |                   |
| Maximum longitudinal stress  |  | σ          | $T_{y,Ed} = M_{y,E}$               | d / Wel.y + N                 | l <sub>Ed</sub> / A = <b>42</b> N/m  | m²  |                   |
| Limiting longitudinal stress - Eq  | 1.6.42   | σ          | $f_{y,lim} = f_y / \gamma$         | <sub>′M0</sub> = <b>355</b> N | /mm²   |   |                   |
|  |  | σ          | $\sigma_{y,Ed}  /  \sigma_{y,lim}$ | = 0.118                       |  |   |                   |
|  |  |            |                                    | -                             | stress is less t   | han limiting long                               | itudinal str      |
| Interaction formula - eq.6.2   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y</sub> , |            |                                    |                               |  |   | . :               |
|  |  |            |                                    |                               |  | ng and axial force                              | e is accepta      |
| Interaction factors k <sub>ij</sub> for men                                      |  |            |                                    | deformatio                    | ons - Table B.2  |   |                   |
| Interaction formulae   | max(0.089, 0.14  | ,          |                                    | ombined l                     | onding and co  | mpression checl                                 | re aro catici     |
| <b>.</b>   |  |            |                                    | ombined l                     | renunny and co   | mpression chech                                 | is ale salisi     |
| Consider Combination 4 - 1.0   | <u>)G + 1.0Q + 0.5S</u>                                | (Serv      | <u>vice)</u>                       |                               |  |   |                   |
| Check design 1730 mm along   | <u>q span</u>  |            |                                    |                               |  |   |                   |
| Check y-y axis deflection - Se   | ection 7.2.1   |            |                                    |                               |  |   |                   |
| Maximum deflection   | δy <b>= 0.9</b> mm                                     |            |                                    | Allowable                     | deflection   | $\delta_{y,Allowable} = r$                      | 10 mm             |
|  |  |            |                                    | δy / δy,Allowa                | able = 0.093   |   |                   |
|  |  |            |                                    | PASS - A                      | llowable deflec  | ction exceeds de                                | sign deflect      |
| <u>Column 2 design</u>   |  |            |                                    |                               |  |   |                   |
| Section details  | UC 152x152x23  | 3 (BS4     | -1)                                |                               |  |   |                   |
| Steel grade  | S355   |            |                                    | Modulus c                     | of elasticity  | E = 210000                                      | N/mm <sup>2</sup> |
| Nominal yield strength   | f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup>          |            |                                    | Nominal u                     | It.tensile strengt   | h f <sub>u</sub> = <b>470</b> N/n               | nm²               |
| u;<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj<br>uj |  |            |                                    |                               | -452-22 (DO 4.4)   |   |                   |
| ↑ <u>+</u> └──   |  |            |                                    | Section                       | <152x23 (BS4-1)<br>depth, h, 152.4 mm  |   |                   |
|  |  |            |                                    | Mass of                       | breadth, b, 152.2 mm<br>section, Mass, 23 kg/m                                       |   |                   |
|  |  |            |                                    | Web thi                       | hickness, t <sub>r</sub> 6.8 mm<br>ckness, t <sub>v</sub> 5.8 mm                     |   |                   |
|  |  |            |                                    | Area of                       | dius, r, 7.6 mm<br>section, A, 2925 mm <sup>2</sup>                                  |   |                   |
| 152.4  |  |            |                                    | Radius                        | of gyration about y-axis, i <sub>y</sub><br>of gyration about z-axis, i <sub>z</sub> | , 36.979 mm                                     |                   |
| 1<br>1<br>2  |  |            |                                    |                               | ection modulus about y-a<br>ection modulus about z-a                                 |   |                   |
|  | → <b></b>  | -5.8       |                                    |                               | ection modulus about y-a<br>ection modulus about z-a                                 |   |                   |
|  |  |            |                                    | Second                        | moment of area about y-a<br>moment of area about z-a                                 | ixis, I <sub>v</sub> , 12498039 mm <sup>4</sup> |                   |
|  |  |            |                                    |                               |  | . 2   |                   |
| 9<br>9<br>₩<br>₩<br>₩  |  |            |                                    |                               |  |   |                   |
| <u> </u>   |  |            |                                    | 1                             |  |   |                   |
| <b></b>  | 152.2  |            |                                    | ▶                             |  |   |                   |
|  |  |            |                                    |                               |  |   |                   |
|  |  |            |                                    |                               |  |   |                   |
| Column 2 results summary   | U  | nit        | Capacit                            | У                             | Maximum  | Utilisation                                     | Result            |
|  |  |            | 204.5                              |                               | 4.0  | 0.000   | <b>D</b> • 00     |
|  | k  | N          | 204.4                              |                               | 1.9  | 0.009   | PASS              |
| Shear resistance (y-y)   |  |            | -                                  |                               |  |   |                   |
|  | k  | Nm         | 58.2                               |                               | 5.7  | 0.099   | PASS              |
| Shear resistance (y-y)<br>Bending resistance (y-y)                               | k  | Nm         | 58.2                               |                               | 5.7  | 0.099   | PASS              |

| BAYLISS  | Project  | W   | illington S  | Sport Pavill  | ion  |  | J                          | ob Ref.<br>6  | 000                              |   |
|--|--|---|--|---|--|--|----------------------------|---|----------------------------------|---|
| CUNSULTING   | Section  |   |  |   |  |  | S                          | Sheet no./rev.  |                                  |   |
| I and Structural Engineering Consultants   |  |   | Structural   | Calculation   |  |  |                            |   | 23                               |   |
| 01332 292192   | Calc. by   | Date  | - ,  |   |  | Date   | A                          | vpp'd   | Da                               | te                                      |
|  | TGB  | 01  | .06.23   |   |  |  |                            |   |                                  |   |
| Comb. bending and axial fo   | rce  |   |  |   |  |  | 0.1                        | 47  |                                  | PASS                                    |
| Deflection (y-y)   |  | mm  | 10   |   | 0.9  |  | 0.0                        | 93  |                                  | PASS                                    |
| Lateral restraint  |  |   |  |   |  |  |                            |   |                                  |   |
| Both flanges have lateral restra   | int at supports  | s only  |  |   |  |  |                            |   |                                  |   |
| Classification of cross sectio   | ns - Section   | 5.5   |  |   |  |  |                            |   |                                  |   |
| Internal compression parts   | Class 1  |   |  | Outstand  | flanges  | 5  | С                          | lass 3  |                                  |   |
|  |  |   |  |   |  |  |                            | Sec   | tion                             | is class                                |
| Check compression - Section  | 6.2.4  |   |  |   |  |  |                            |   |                                  |   |
| Design compression force   | N <sub>Ed</sub> = <b>21.5</b> kl   | N   |  | Design re<br>N <sub>Ed</sub> / N <sub>c,R</sub>   |  | e of section<br>21   | N                          | $_{c,Rd} = N_{pl,Rd}$   | = 10                             | 38.2 kN                                 |
|  |  | PAS   | S - Desig  | n compre  | ssion  | resistance e   | xcee                       | eds design  | con                              | npressi                                 |
| Check y-y axis flexural buckli   | ng resistanc   | e - Secti   | on 6.3.1.1   | I   |  |  |                            |   |                                  |   |
| Design buckling resistance   | N <sub>b,y,Rd</sub> = 868.   | <b>7</b> kN   |  | $N_{Ed}$ / $N_{b,y,}$   |  | )25<br>resistance e  | xcee                       | eds desian  | con                              | npressi                                 |
| Check z-z axis flexural buckli   | na resistanc   |   |  | -   | 0  |  |                            | U   |                                  |   |
| Design buckling resistance   | N <sub>b,z,Rd</sub> = 524.   |   | 511 0.0.1.1  | N <sub>Ed</sub> / N <sub>b.z.</sub>   | Rd <b>= 0.(</b>  | )41  |                            |   |                                  |   |
| g  | ·  |   | PASS - L   |   |  | resistance e   | xcee                       | eds design  | con                              | npressi                                 |
| Check torsional and torsiona   | l-flexural buc   | klina re  | sistance   | - Section (   | 6.3.1.1  |  |                            | _   |                                  | -                                       |
| Design buckling resistance   | N <sub>b,T,Rd</sub> = 671  | -   |  | NEd / Nb.T.   |  | 032  |                            |   |                                  |   |
| 5 5  | _,.,   |   | PASS - L   |   |  | resistance e   | xcee                       | eds design  | con                              | npressi                                 |
| Check design at end of span  |  |   |  | -   | _  |  |                            | -   |                                  | -                                       |
|  |  |   |  |   |  |  |                            |   |                                  |   |
| Check shear - Section 6.2.6  |  |   |  |   |  |  |                            |   |                                  |   |
|  |  |   |  | <b>D</b> · · ·  |  |  | .,                         | 004   |                                  |   |
| Design shear force   | V <sub>y,Ed</sub> = <b>1.9</b> kM  | N   |  | Design sh   |  |  | V                          | pl,y,Rd = <b>204</b> .  | . <b>4</b> kN                    | I                                       |
| Design shear force   | V <sub>y,Ed</sub> = <b>1.9</b> kM  | N   | PAS  | V <sub>y,Ed</sub> / V <sub>pl,</sub>  | <sub>y,Rd</sub> = <b>0</b>   | .009   |                            |   |                                  |   |
| ,  |  | N   | PAS  | V <sub>y,Ed</sub> / V <sub>pl,</sub>  | <sub>y,Rd</sub> = <b>0</b>   |  |                            |   |                                  |   |
| Check bending moment - Sec   | tion 6.2.5   |   | PAS  | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig  | <sub>y,Rd</sub> = 0<br>n shea  | .009<br>er resistance  | exc                        | eeds desig  | ın sl                            | near for                                |
| ,  |  |   | PAS  | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig<br>Bending r   | <sub>y,Rd</sub> = <b>0</b><br><i>n shea</i><br>resistar  | . <b>009</b><br>ar resistance  | exc                        |   | ın sl                            | near for                                |
| Check bending moment - Sec   | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl   | Nm  |  | V <sub>y,Ed</sub> / V <sub>pl</sub> ,<br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub>  | <sub>y,Rd</sub> = 0<br><i>n shea</i><br>resistar<br><sub>,y,Rd</sub> = 0   | . <b>009</b><br>ar resistance  | exc<br>M                   | eeds desig<br><sub>c,y,Rd</sub> = 58.2  | <b>in sl</b><br>kNr              | near for                                |
| Check bending moment - Sec   | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br><i>PA</i> S  | Nm<br>SS - Desi   |  | V <sub>y,Ed</sub> / V <sub>pl</sub> ,<br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub>  | <sub>y,Rd</sub> = 0<br><i>n shea</i><br>resistar<br><sub>,y,Rd</sub> = 0   | .009<br>Ir resistance<br>Ince moment<br>0.099  | exc<br>M                   | eeds desig<br><sub>c,y,Rd</sub> = 58.2  | <b>in sl</b><br>kNr              | n <b>ear for</b> a                      |
| Check bending moment - Sec<br>Design bending moment  | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br><i>PA</i> S  | Nm<br>SS - Desi<br>1  |  | V <sub>y,Ed</sub> / V <sub>pl</sub> ,<br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub>  | <sub>y,Rd</sub> = 0<br>n shea<br>resistar<br><sub>y,Rd</sub> = 0<br>nnce m   | .009<br>nr resistance<br>nce moment<br>).099<br>noment exce  | exc<br>M                   | eeds desig<br><sub>c,y,Rd</sub> = 58.2  | <b>in sl</b><br>kNr              | near for                                |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S   | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA:<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2  | Nm<br>S <i>S - Desi</i><br>1<br>2 kNm   | ign bendi  | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub><br>ing resista  | <sub>y,Rd</sub> = 0<br>n shea<br>esistar<br><sub>y,Rd</sub> = 0<br>nce m   | .009<br>nr resistance<br>nce moment<br>).099<br>noment exce  | exc<br>M<br>eds o          | eeds desig<br><sub>c.y.Rd</sub> = 58.2<br>design ben                              | <b>gn sl</b><br>kNr<br>ading     | near for<br>n<br>g mome                 |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S   | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS  | Nm<br>SS - Desi<br>1<br>2 kNm<br>SS - Desi  | ign bendi  | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub><br>ing resista  | <sub>y,Rd</sub> = 0<br>n shea<br>esistar<br><sub>y,Rd</sub> = 0<br>nce m   | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099   | exc<br>M<br>eds o          | eeds desig<br><sub>c.y.Rd</sub> = 58.2<br>design ben                              | <b>gn sl</b><br>kNr<br>ading     | near for<br>n<br>g mome                 |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment   | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS  | Nm<br>SS - Desi<br>1<br>2 kNm<br>SS - Desi<br>.2.9  | ign bendi<br>gn buckli   | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>e</sub><br>ing resista<br>M <sub>y,Ed</sub> / M <sub>b</sub>  | <sub>y,Rd</sub> = 0<br>n shea<br>esistar<br><sub>y,Rd</sub> = 0<br>nnce m<br>y, <sub>Rd</sub> = 0<br>nnce m  | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099   | exc<br>M<br>eds o          | eeds desig<br><sub>c.y.Rd</sub> = 58.2<br>design ben                              | <b>gn sl</b><br>kNr<br>ading     | near for<br>n<br>g mome                 |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial force  | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PAS<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6  | Nm<br>SS - Desi<br>1<br>2 kNm<br>SS - Desi<br>.2.9<br>5   | ign bendi<br>gn buckli<br><sub>y,Ed</sub> = M <sub>y,E</sub>   | V <sub>y,Ed</sub> / V <sub>pl,</sub><br>SS - Desig<br>Bending r<br>M <sub>y,Ed</sub> / M <sub>e</sub><br>ing resista<br>M <sub>y,Ed</sub> / M <sub>b</sub>  | <sub>y,Rd</sub> = 0<br>n shea<br>resistar<br>y, <sub>y,Rd</sub> = 0<br>nce m<br>, <sub>y,Rd</sub> = 0<br>nce m   | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099<br>noment exce  | exc<br>M<br>eds o          | eeds desig<br><sub>c.y.Rd</sub> = 58.2<br>design ben                              | <b>gn sl</b><br>kNr<br>ading     | near for<br>n<br>g mome                 |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress  | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PAS<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6  | Nm<br>SS - Desi<br>1<br>2 kNm<br>SS - Desi<br>.2.9<br>a   | ign bendi<br>gn buckli<br><sub>y,Ed</sub> = M <sub>y,E</sub>   | V <sub>y,Ed</sub> / V <sub>pl,</sub><br><b>SS - Desig</b><br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub><br><b>ing resista</b><br>M <sub>y,Ed</sub> / M <sub>b</sub><br><b>ing resista</b><br>(M <sub>y,Ed</sub> / M <sub>b</sub><br>(M <sub>y,Ed</sub> / M <sub>b</sub> )<br>(M <sub>y,Ed</sub> / M <sub>b</sub> )   | <sub>y,Rd</sub> = 0<br>n shea<br>resistar<br>y, <sub>y,Rd</sub> = 0<br>nce m<br>, <sub>y,Rd</sub> = 0<br>nce m   | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099<br>noment exce  | exc<br>M<br>eds o          | eeds desig<br><sub>c.y.Rd</sub> = 58.2<br>design ben                              | <b>gn sl</b><br>kNr<br>ading     | near for<br>n<br>g mome                 |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress  | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6<br>.6.42                                     | Nm<br>SS - Desi<br>1<br>2 kNm<br>SS - Desi<br>3<br>.2.9<br>5<br>5<br>.3<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5 | ign bendi<br>gn buckli<br>y,Ed = My,E<br>y,lim = fy / γ<br>y,Ed / σy,lim   | V <sub>y,Ed</sub> / V <sub>pl</sub> ,<br><b>S</b> - <b>Desig</b><br>Bending r<br>M <sub>y,Ed</sub> / M <sub>c</sub><br><b>ing resista</b><br>M <sub>y,Ed</sub> / M <sub>b</sub><br><b>ing resista</b><br>(M <sub>y,Ed</sub> / M <sub>b</sub><br><b>ing resista</b><br>(M <sub>y,Ed</sub> / M <sub>b</sub><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b><br><b>ing resista</b>   | y,Rd = <b>0</b><br><i>n shea</i><br>resistar<br>y,Rd = <b>0</b><br><i>nce m</i><br><i>y</i> ,Rd = <b>0</b><br><i>nce m</i><br><i>nce m</i><br><i>N</i> Ed / A                  | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099<br>noment exce  | M<br>eds o                 | eeds desig<br><sub>c,y,Rd</sub> = 58.2<br>design ben<br>design ben                | ın sl<br>! kNr<br>ading          | n<br>n<br>g mome<br>g mome              |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress  | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6<br>.6.42                                     | Nm<br>SS - Desi<br>2 kNm<br>SS - Desi<br>.2.9<br>o<br>3<br>SS - Ma  | ign bendi<br>gn buckli<br>y,Ed = My,E<br>y,Iim = fy / γ<br>y,Ed / σy,Iim<br>κimum Io   | $V_{y,Ed} / V_{pl}$ ,<br>SS - Desig<br>Bending r<br>$M_{y,Ed} / M_c$<br>ing resistat<br>$M_{y,Ed} / M_b$<br>ing resistat<br>$M_{y,Ed} / W_{el,y} + 1$<br>$Y_{M0} = 355 N$<br>= 0.118<br>ngitudina   | y,Rd = <b>0</b><br><i>n shea</i><br>resistar<br>y,Rd = <b>0</b><br><i>nce m</i><br><i>y</i> ,Rd = <b>0</b><br><i>nce m</i><br><i>nce m</i><br><i>N</i> Ed / A                  | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099<br>noment exce<br>= 42 N/mm <sup>2</sup>  | M<br>eds o                 | eeds desig<br><sub>c,y,Rd</sub> = 58.2<br>design ben<br>design ben                | ın sl<br>! kNr<br>ading          | n<br>n<br>g mome<br>g mome              |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress<br>Limiting longitudinal stress - Eq                                 | tion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PA5<br>e - Section 6<br>.6.42<br>PA                               | Nm<br>SS - Desi<br>2 kNm<br>SS - Desi<br>.2.9<br>o<br>SS - Ma<br>M <sub>y,Ed</sub> / Ma   | ign bendi<br>gn buckli<br>y,Ed = My,E<br>y,Iim = fy / γ<br>y,Ed / σy,Iim<br>ximum Io<br>c,y,Rd = <b>0.1</b>                      | $V_{y,Ed} / V_{pl}$<br><b>SS - Desig</b><br>Bending r<br>$M_{y,Ed} / M_{c}$<br>ing resistation<br>$M_{y,Ed} / M_{b}$<br>ing resistation<br>$M_{y,Ed} / M_{b}$<br>$M_{y,Ed} / M_{b}$<br>$M_{y$                 | y,Rd = <b>0</b><br><i>n shea</i><br>resistar<br>y,Rd = <b>0</b><br><i>ance m</i><br><i>y</i> ,Rd = <b>0</b><br><i>ance m</i><br>NEd / A<br>N/mm <sup>2</sup><br><i>I stres</i> | .009<br>nr resistance<br>nce moment<br>0.099<br>noment exce<br>0.099<br>noment exce<br>= 42 N/mm <sup>2</sup>  | exc<br>M<br>eds (<br>eds ( | eeds desig<br><sub>c,y,Rd</sub> = 58.2<br>design ben<br>design ben<br>iting longi | ın sl<br>! kNr<br>nding<br>nding | n<br>n<br>g mome<br>g mome<br>nal stre  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress<br>Limiting longitudinal stress - Eq                                 | etion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6<br>.6.42<br>PA<br>NEd / N <sub>c,Rd</sub> + | Nm<br>SS - Desi<br>KNm<br>SS - Desi<br>SS - Desi<br>G<br>SS - Ma<br>M <sub>y,Ed</sub> / Ma<br>PAS   | ign bendi<br>gn buckli<br>y,Ed = My,E<br>y,Iim = fy / γ<br>y,Ed / σy,Iim<br>ximum Io<br>c,y,Rd = 0.1<br>SS - Utilis              | $V_{y,Ed} / V_{pl}$ ,<br>SS - Desig<br>Bending r<br>$M_{y,Ed} / M_c$<br>ing resista<br>$M_{y,Ed} / M_b$<br>ing resista<br>$M_{y,Ed} / M_b$<br>$M_{y,Ed} $ | y,Rd = 0<br>n shea<br>resistar<br>y,Rd = 0<br>nce m<br>NEd / A<br>N/mm <sup>2</sup><br>I stress<br>ombin   | .009<br>In resistance<br>Ince moment<br>0.099<br>Inoment exce<br>0.099<br>Inoment exce<br>= 42 N/mm <sup>2</sup><br>Is is less that<br>ed bending of | exc<br>M<br>eds (<br>eds ( | eeds desig<br><sub>c,y,Rd</sub> = 58.2<br>design ben<br>design ben<br>iting longi | ın sl<br>! kNr<br>nding<br>nding | n<br>n<br>g mome<br>g mome<br>nal stre  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Check bending and axial forc<br>Maximum longitudinal stress<br>Limiting longitudinal stress - Eq<br>Interaction formula - eq.6.2 | etion 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kl<br>PA3<br>Section 6.3.2.<br>M <sub>b,y,Rd</sub> = 58.2<br>PAS<br>e - Section 6<br>.6.42<br>PA<br>NEd / N <sub>c,Rd</sub> + | Nm<br>SS - Desi<br>2 kNm<br>SS - Desi<br>3<br>.2.9<br>3<br>SS - Ma<br>My,Ed / Ma<br>PAS<br>otible to 1  | ign bendi<br>gn buckli<br>y,Ed = My,E<br>y,Iim = fy / γ<br>y,Ed / σy,Iim<br>ximum Io<br>s,y,Rd = 0.1<br>SS - Utilis<br>corsional | $V_{y,Ed} / V_{pl}$ ,<br>SS - Desig<br>Bending r<br>$M_{y,Ed} / M_c$<br>ing resista<br>$M_{y,Ed} / M_b$<br>ing resista<br>$M_{y,Ed} / M_b$<br>$M_{y,Ed} $ | y,Rd = 0<br>n shea<br>resistar<br>y,Rd = 0<br>nce m<br>NEd / A<br>N/mm <sup>2</sup><br>I stress<br>ombin   | .009<br>In resistance<br>Ince moment<br>0.099<br>Inoment exce<br>0.099<br>Inoment exce<br>= 42 N/mm <sup>2</sup><br>Is is less that<br>ed bending of | exc<br>M<br>eds (<br>eds ( | eeds desig<br><sub>c,y,Rd</sub> = 58.2<br>design ben<br>design ben<br>iting longi | ın sl<br>! kNr<br>nding<br>nding | n<br>n<br>g mome<br>g mome<br>nal strea |



| Beam 1 results summary        | Unit | Capacity | Maximum | Utilisation | Result |
|-------------------------------|------|----------|---------|-------------|--------|
| Shear resistance (y-y)        | kN   | 335.5    | 6.5     | 0.019       | PASS   |
| Bending resistance (y-y)      | kNm  | 42.2     | 11.1    | 0.264       | PASS   |
| Compression resistance        | kN   | 121.5    | 1.9     | 0.016       | PASS   |
| Comb. bending and axial force |      |          |         | 0.279       | PASS   |
| Deflection (y-y)              | mm   | 23.1     | 5.6     | 0.243       | PASS   |

Lateral restraint

Both flanges have lateral restraint at supports onlyClassification of cross sections - Section 5.5Internal compression partsClass 1

Outstand flanges

Class 1 Section is class 1

|   | Project  |   |  |  | Job Ref.   |   |
|---|--|---|--|--|--|---|
| BAYLISS   |  | Willington S  | Sport Pavillion  |  | 6  | 000   |
| CONSULTING  | Section  |   |  |  | Sheet no./rev.   |   |
| I and Structural Engineering Consultants  |  |   | Calculations   | 1  |  | 25  |
| 01332 292192  | Calc. by   | Date  | Chk'd by   | Date   | App'd  | Date  |
|   | TGB  | 01.06.23  |  |  |  |   |
| Check compression - Section   | n 6.2.4  |   |  |  |  |   |
| Design compression force  | N <sub>Ed</sub> = <b>1.9</b> kN  |   | Design resista   | ance of section  | $N_{c,Rd} = N_{pl,Rd}$   | = <b>1038.2</b> kN  |
|   |  |   | $N_{Ed} / N_{c,Rd} = 0$  | .002   |  |   |
|   |  | PASS - Desig  | gn compressio  | on resistance ex   | xceeds design  | compressi   |
| Check y-y axis flexural buckl   | ing resistance -   | Section 6.3.1.  | 1  |  |  |   |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 908 kN   |   | $N_{Ed} / N_{b,y,Rd} =$  | 0.002  |  |   |
|   |  | PASS - L  | Design bucklir   | ng resistance ex   | xceeds design  | compressi   |
| Check z-z axis flexural buckli  | ing resistance -   | Section 6.3.1.1   | 1  |  |  |   |
| Design buckling resistance  | N <sub>b,z,Rd</sub> = <b>121.5</b> k   | N   | $N_{Ed} / N_{b,z,Rd} =$  | 0.016  |  |   |
|   |  | PASS - I  | Design bucklir   | ng resistance ex   | xceeds design  | compressi   |
| Check torsional and torsiona  | I-flexural buckli  | ng resistance   | - Section 6.3.1  | .1   |  |   |
| Design buckling resistance  | N <sub>b,T,Rd</sub> = <b>541.7</b> k   | Ν   | $N_{Ed} / N_{b,T,Rd} =$  | 0.004  |  |   |
|   |  | PASS - L  | Design bucklir   | ng resistance ex   | xceeds design  | compressi   |
| Check design 4150 mm along  | <u>ı span</u>  |   |  |  |  |   |
| Check bending moment - Sec  | ction 6.2.5  |   |  |  |  |   |
| Design bending moment   | M <sub>y,Ed</sub> = <b>11.1</b> kNr  | n   | Bending resis  | tance moment   | M <sub>c,y,Rd</sub> = 139.   | <b>5</b> kNm  |
| 5 5   | ,,   |   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>  |  | -,,,   |   |
|   | PASS   | Design bend   | ing resistance   | moment excee   | eds design ben   | ding mome   |
| Check buckling resistance - S   | Section 6.3.2.1  |   |  |  |  |   |
| Buckling resistance moment  | M <sub>b,y,Rd</sub> = <b>42.2</b> kN   | lm  | M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>  | = 0.264  |  |   |
|   | PASS -   | Design buckl  | ing resistance   | moment excee   | eds design ben   | ding mome   |
| Check bending and axial force   | e - Section 6.2.9  |   |  |  |  |   |
| Bending and axial force check   | N <sub>y,lim</sub> = <b>142.9</b> kN   |   | $N_{Ed} / N_{y,lim} = 0$   | .013   |  |   |
| Allowance need not be ma  | ade for the effec  | t of the axial f  | orce on the pl   | astic resistance   | e moment abou  | it the y-y a  |
| Interaction factors kij for men   | nbers susceptib  | le to torsional   | deformations   | - Table B.2  |  |   |
| Interaction formulae  | max(0.247, 0.27  | 9) = <b>0.279</b>   |  |  |  |   |
|   |  | DACC C  |  |  |  |   |
|   |  | PA33 - C  | Combined ben   | ding and compi   | ression checks   | are satisfi   |
| Check design at end of span   |  | PA33 - 0  | Combined ben   | ding and compi   | ression checks   | are satisfi   |
| Check design at end of span<br>Check shear - Section 6.2.6  |  | PA33 - U  | Combined ben   | ding and compi   | ression checks   | are satisfi   |
|   | V <sub>y,Ed</sub> = <b>6.5</b> kN  | PA33 - U  |  |  |  |   |
| Check shear - Section 6.2.6   | V <sub>y,Ed</sub> = <b>6.5</b> kN  | PA33 - U  | Design shear<br>Vy,Ed / Vc,y,Rd =  | resistance   | ression checks<br>$V_{c,y,Rd} = V_{pl,y,F}$  |   |
| Check shear - Section 6.2.6   | V <sub>y,Ed</sub> = <b>6.5</b> kN  |   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =  | resistance   | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub>  | ad = <b>204.4</b> kl  |
| Check shear - Section 6.2.6   |  |   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =  | resistance<br>• 0.032  | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub>  | ad = <b>204.4</b> kl  |
| Check shear - Section 6.2.6<br>Design shear force   |  | PAS   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b>   | resistance<br>• 0.032  | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub>  | ad = <b>204.4</b> kl<br>n shear for                                     |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec   | ction 6.2.5  | PAS   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b>   | resistance<br>= <b>0.032</b><br>pear resistance<br>tance moment                                    | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig   | ad = <b>204.4</b> kl<br>n shear for                                     |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec   | ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm   | PAS   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b><br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>   | resistance<br>= <b>0.032</b><br>pear resistance<br>tance moment                                    | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.                   | ad = <b>204.4</b> kl<br><i>n shear for</i><br>5 kNm                     |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec   | ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm<br><i>PASS</i> -  | PAS   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b><br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>   | resistance<br>• 0.032<br>• dear resistance<br>tance moment<br>= 0.041                              | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.                   | ad = <b>204.4</b> kl<br><i>n shear for</i><br>5 kNm                     |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec<br>Design bending moment  | ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kN                  | PA:<br>- Design bend  | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b><br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br><b>ing resistance</b><br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub> | resistance<br>= 0.032<br>tear resistance<br>tance moment<br>= 0.041<br>= moment excee<br>= 0.136   | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.<br>eds design ben | ad = <b>204.4</b> kl<br>n shear for<br>5 kNm<br>ding mome               |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S                                 | ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kN                  | PA:<br>- Design bend  | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br><b>SS - Design sh</b><br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br><b>ing resistance</b><br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub> | resistance<br>= 0.032<br>tear resistance<br>tance moment<br>= 0.041<br>= moment excee              | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.<br>eds design ben | ad = <b>204.4</b> kl<br><i>n shear for</i><br>5 kNm<br><i>ding mome</i> |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S                                 | Ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kN<br><i>PASS</i> - | PAS<br>• Design bend<br>Im<br>Design buckl                    | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br>SS - Design sh<br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ing resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>               | resistance<br>ear resistance<br>tance moment<br>= 0.041<br>moment excee<br>= 0.136<br>moment excee | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.<br>eds design ben | ad = <b>204.4</b> kl<br><i>n shear for</i><br>5 kNm<br><i>ding mome</i> |
| Check shear - Section 6.2.6<br>Design shear force<br>Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - Sec<br>Buckling resistance moment | Ction 6.2.5<br>M <sub>y,Ed</sub> = 5.7 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kN<br><i>PASS</i> - | PAS<br>- Design bend<br>Im<br>Design buckl<br>le to torsional | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =<br>SS - Design sh<br>Bending resis<br>M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ing resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>               | resistance<br>ear resistance<br>tance moment<br>= 0.041<br>moment excee<br>= 0.136<br>moment excee | V <sub>c,y,Rd</sub> = V <sub>pl,y,F</sub><br>exceeds desig<br>M <sub>c,y,Rd</sub> = 139.<br>eds design ben | ad = <b>204.4</b> kl<br><i>n shear for</i><br>5 kNm<br><i>ding mome</i> |

|  | Project                    |            |          |      | Job Ref.       |      |
|--|----------------------------|------------|----------|------|----------------|------|
| BAYLISS                                      | Willington Sport Pavillion |            |          |      | 6000           |      |
| CONSULTING                                   | Section                    |            |          |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |                            | Structural | 26       |      |                |      |
| 01332 292192                                 | Calc. by                   | Date       | Chk'd by | Date | App'd          | Date |
|  | TGB                        | 01.06.23   |          |      |                |      |

### Consider Combination 4 - 1.0G + 1.0Q + 0.5S (Service)

### Check design 4150 mm along span

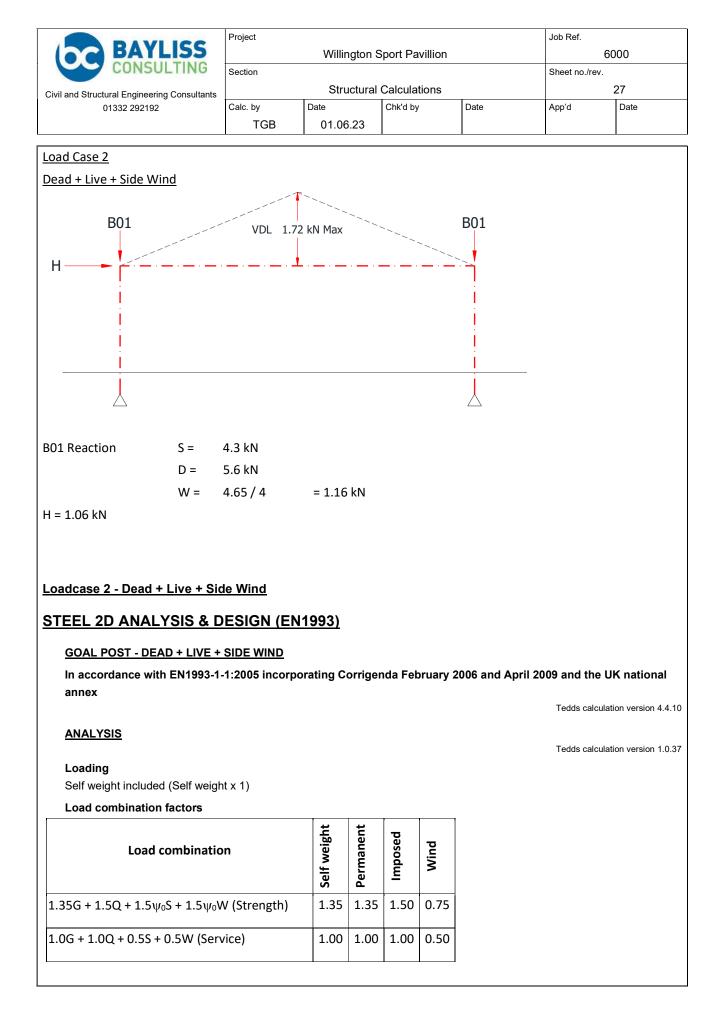
Check y-y axis deflection - Section 7.2.1

Maximum deflection  $\delta_y = 5.6 \text{ mm}$ 

Allowable deflection  $\delta_y / \delta_{y,Allowable} = 0.243$ 

 $\delta_{y,Allowable}$  = 23.1 mm

PASS - Allowable deflection exceeds design deflection



|  | Project  |              | Job Ref.       |      |       |      |
|--|----------|--------------|----------------|------|-------|------|
| BAYLISS                                      |          | Willington S | 6000           |      |       |      |
| CONSULTING                                   | Section  |              | Sheet no./rev. |      |       |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      | 28    |      |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date | App'd | Date |
|  | TGB      | 01.06.23     |                |      |       |      |

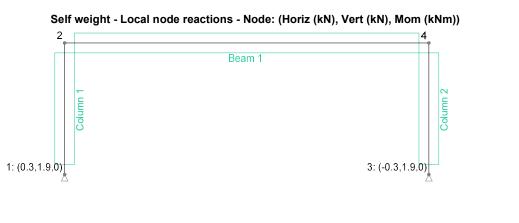
| Load combination                                    | Self weight | Permanent | Imposed | Wind |
|---|-------------|-----------|---------|------|
| $1.35G + 1.5\psi_0Q + 1.5S + 1.5\psi_0W$ (Strength) | 1.35        | 1.35      | 1.05    | 0.75 |
| $1.0G + 1.0\psi_0Q + 1.0S + 0.5W$ (Service)         | 1.00        | 1.00      | 0.70    | 0.50 |
| $1.35G + 1.5\psi_0Q + 1.5\psi_0S + 1.5W$ (Strength) | 1.35        | 1.35      | 1.05    | 1.50 |
| $1.0G + 1.0\psi_0Q + 0.5S + 1.0W$ (Service)         | 1.00        | 1.00      | 0.70    | 1.00 |

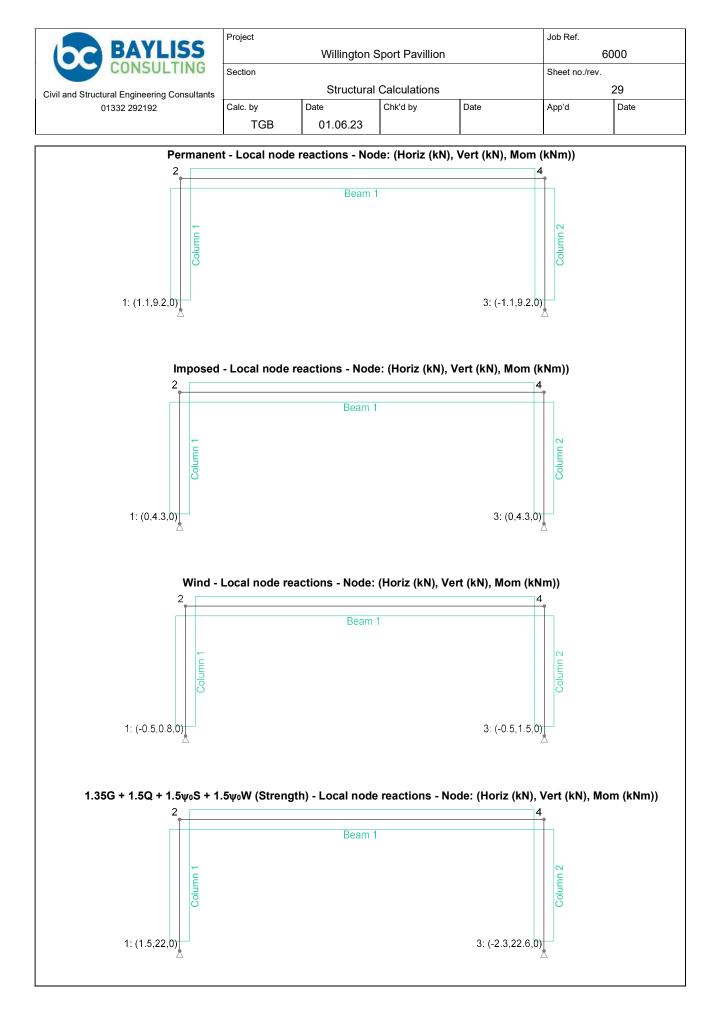
### Member Loads

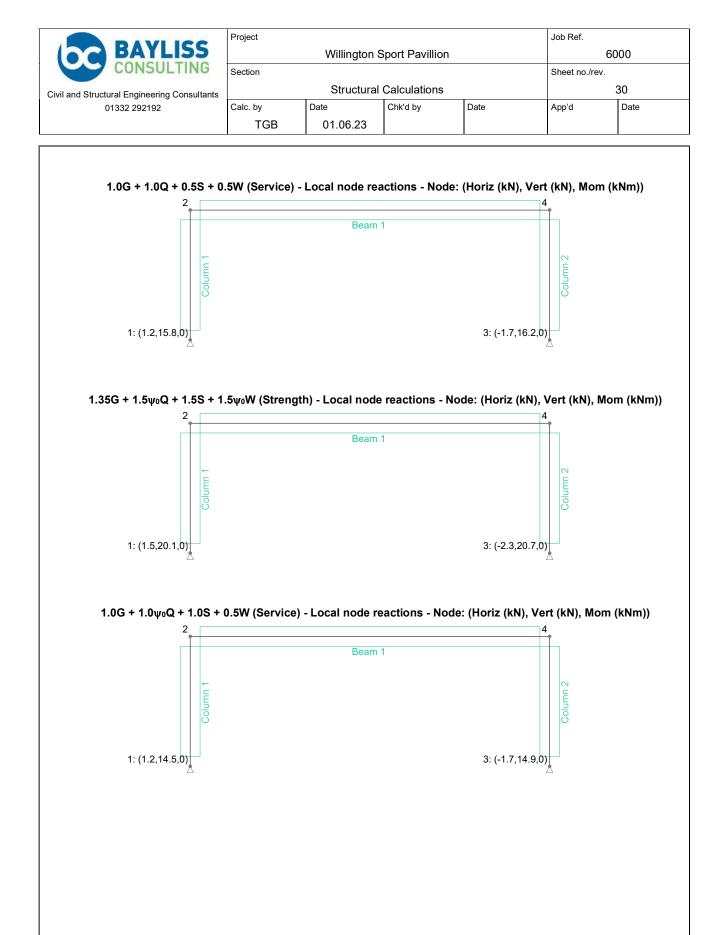
| Member Eddus |           |            |             |  |
|--------------|-----------|------------|-------------|--|
| Member       | Load case | Load Type  | Orientation | Description                            |
| Beam 1       | Permanent | VDL        | GlobalZ     | 0 kN/m at 0 m to 1.72 kN/m at 4.15 m   |
| Beam 1       | Permanent | VDL        | GlobalZ     | 1.72 kN/m at 4.15 m to 0 kN/m at 8.3 m |
| Column 1     | Permanent | Point load | GlobalZ     | 5.6 kN at 3 m                          |
| Column 2     | Permanent | Point load | GlobalZ     | 5.6 kN at 3 m                          |
| Column 1     | Imposed   | Point load | GlobalZ     | 4.3 kN at 3 m                          |
| Column 2     | Imposed   | Point load | GlobalZ     | 4.3 kN at 3 m                          |
| Column 1     | Wind      | Point load | GlobalZ     | 1.16 kN at 3 m                         |
| Column 1     | Wind      | Point load | GlobalX     | 1.06 kN at 3 m                         |
| Column 2     | Wind      | Point load | GlobalZ     | 1.16 kN at 3 m                         |

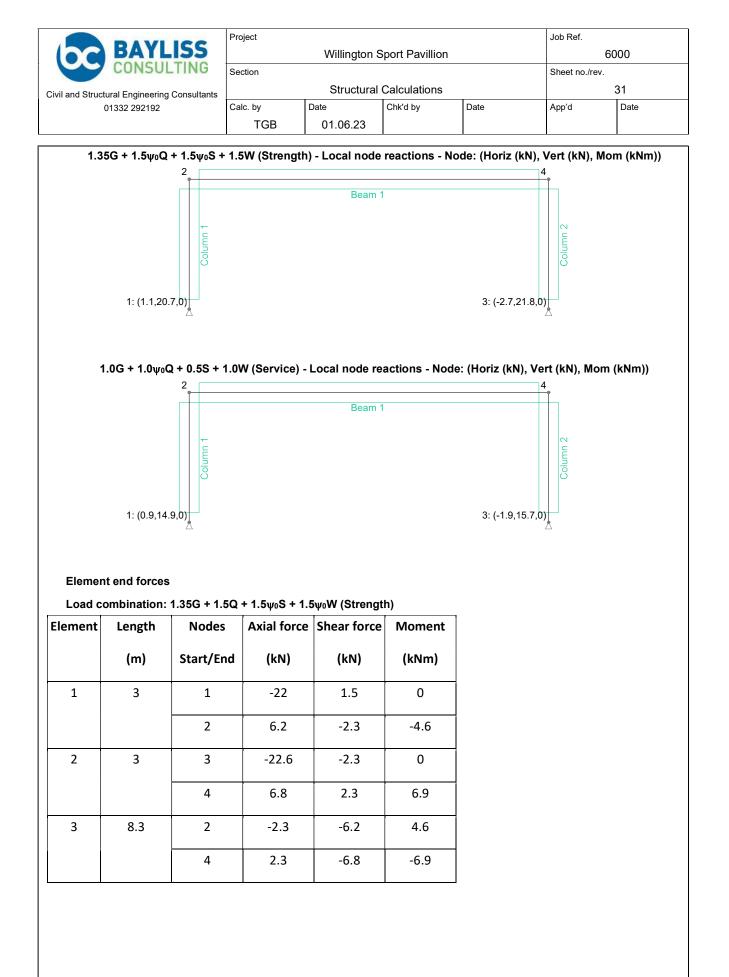
### <u>Results</u>

Reactions









|  | Project                    |          |                |      | Job Ref. |      |
|--|----------------------------|----------|----------------|------|----------|------|
| BAYLISS                                      | Willington Sport Pavillion |          |                |      | 6000     |      |
| CONSULTING                                   | Section                    |          | Sheet no./rev. |      |          |      |
| Civil and Structural Engineering Consultants | Structural Calculations    |          |                |      | 32       |      |
| 01332 292192                                 | Calc. by                   | Date     | Chk'd by       | Date | App'd    | Date |
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| Load c  | ombination: | 1.0G + 1.0Q + | 0.5S + 0.5W ( | Service)    |        |
|---------|-------------|---------------|---------------|-------------|--------|
| Element | Length      | Nodes         | Axial force   | Shear force | Moment |
|         | (m)         | Start/End     | (kN)          | (kN)        | (kNm)  |
| 1       | 3           | 1             | -15.8         | 1.2         | 0      |
|         |             | 2             | 4.6           | -1.7        | -3.5   |
| 2       | 3           | 3             | -16.2         | -1.7        | 0      |
|         |             | 4             | 5             | 1.7         | 5      |
| 3       | 8.3         | 2             | -1.7          | -4.6        | 3.5    |
|         |             | 4             | 1.7           | -5          | -5     |

Load combination: 1.35G + 1.5y<sub>0</sub>Q + 1.5S + 1.5y<sub>0</sub>W (Strength)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -20.1       | 1.5         | 0      |
|         |        | 2         | 6.2         | -2.3        | -4.6   |
| 2       | 3      | 3         | -20.7       | -2.3        | 0      |
|         |        | 4         | 6.8         | 2.3         | 6.9    |
| 3       | 8.3    | 2         | -2.3        | -6.2        | 4.6    |
|         |        | 4         | 2.3         | -6.8        | -6.9   |

Load combination:  $1.0G + 1.0\psi_0Q + 1.0S + 0.5W$  (Service)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -14.5       | 1.2         | 0      |
|         |        | 2         | 4.6         | -1.7        | -3.5   |
| 2       | 3      | 3         | -14.9       | -1.7        | 0      |
|         |        | 4         | 5           | 1.7         | 5      |
| 3       | 8.3    | 2         | -1.7        | -4.6        | 3.5    |

|  | Project  |              |                |      |
|--|----------|--------------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion | Date |
| CONSULTING                                   | Section  |              |                |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date |
|  | TGB      | 01.06.23     |                |      |

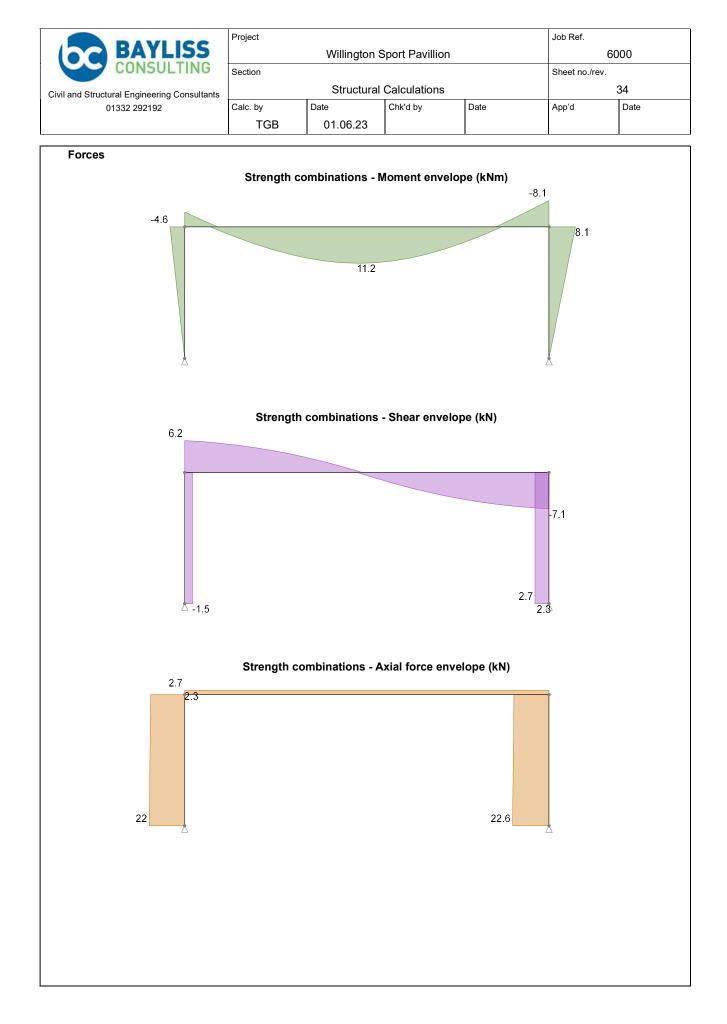
| Element | Length<br>(m) | Nodes<br>Start/End | Axial force<br>(kN) | Shear force<br>(kN) | Moment<br>(kNm) |
|---------|---------------|--------------------|---------------------|---------------------|-----------------|
|         |               | 4                  | 1.7                 | -5                  | -5              |

Load combination:  $1.35G + 1.5\psi_0Q + 1.5\psi_0S + 1.5W$  (Strength)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -20.7       | 1.1         | 0      |
|         |        | 2         | 6           | -2.7        | -3.4   |
| 2       | 3      | 3         | -21.8       | -2.7        | 0      |
|         |        | 4         | 7.1         | 2.7         | 8.1    |
| 3       | 8.3    | 2         | -2.7        | -6          | 3.4    |
|         |        | 4         | 2.7         | -7.1        | -8.1   |

Load combination:  $1.0G + 1.0\psi_0Q + 0.5S + 1.0W$  (Service)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -14.9       | 0.9         | 0      |
|         |        | 2         | 4.5         | -1.9        | -2.7   |
| 2       | 3      | 3         | -15.7       | -1.9        | 0      |
|         |        | 4         | 5.2         | 1.9         | 5.8    |
| 3       | 8.3    | 2         | -1.9        | -4.5        | 2.7    |
|         |        | 4         | 1.9         | -5.2        | -5.8   |



| BAY  | <b>ISS</b>  | Project                                     | v        | Villington       | Sport Pavill                       | ion                                    | Job Ref.  | 6000         |  |
|--|---|---|----------|------------------|------------------------------------|--|---|--------------|--|
| CONS   | ULTING  | Section                                     |          | ~                |                                    |  | Sheet no./rev.  |              |  |
| I and Structural Enginee   | ering Consultants                                     |   |          | Structura        | al Calculation                     | าร                                     |   | 35           |  |
| 01332 2921   | •   | Calc. by                                    | Date     |                  | Chk'd by                           | Date                                   | App'd   | Date         |  |
|  |   | TGB   | 0        | 1.06.23          |                                    |  |   |              |  |
| Member results   |   |   |          |                  |                                    |  |   |              |  |
| Envelope - Serv  | ice combinat  | ions  |          |                  |                                    |  |   |              |  |
| Member   | De  | eflectio                                    | n        |                  |                                    |  |   |              |  |
|  | Pos   | Max   |          | Pos              | Min                                |  |   |              |  |
|  | (m)   | (mm)  |          | (m)              | (mm)                               |  |   |              |  |
| Column 1   | 3   | 2.6   | 1        | L.021 -0.2 (min) |                                    | n)                                     |   |              |  |
| Column 2   | 2.301   | 3   |          | 0                | 0                                  |  |   |              |  |
| Beam 1   | 4.02  | 5.6 (max)                                   |          | 0                | 0.1                                |  |   |              |  |
| Partial factors -  | Section 6.1   | γ <sub>M0</sub> = <b>1</b>                  |          | 1                | γ <sub>M1</sub> = <b>1</b>         |  | γ <sub>M2</sub> = <b>1.1</b>                              |              |  |
| Steel grade<br>Nominal yield stre  | ength   | S355<br>f <sub>y</sub> = <b>355</b> N/mr    | m²       |                  |                                    | of elasticity<br>ult.tensile stren     | E = <b>210000</b><br>Igth f <sub>u</sub> = <b>470</b> N/m |              |  |
| Column 1 resu  | lts summary   | 1   | Unit     | Сарас            | ity                                | Maximum                                | Utilisation   | Result       |  |
| Shear resistand  | се (у-у)  |   | kN       | 204.4            |                                    | 1.5                                    | 0.007   | PASS         |  |
| Bending resista  | ance (y-y)  |   | kNm      | 58.2             |                                    | 4.6                                    | 0.078   | PASS         |  |
| Compression r  | esistance   |   | kN       | 524.3            |                                    | 22.0                                   | 0.042   | PASS         |  |
| Comb. bending  | g and axial fo  | orce  |          |                  |                                    |  | 0.126   | PASS         |  |
| Deflection (y-y  | ')  |   | mm       | 10               |                                    | 2.6                                    | 0.257   | PASS         |  |
| Lateral restraint<br>Both flanges have<br><u>Consider Combi</u><br>Classification of | e lateral restra<br>ination 1 - 1.3<br>f cross sectio | <u>35G + 1.5Q + 1</u><br>ons - Section      | I.5ψ₀S + | - <u>1.5ψ₀</u> ₩ |                                    | _                                      |   |              |  |
| Internal compress  | sion parts  | Class 1                                     |          |                  | Outstand                           | flanges                                | Class 3<br>Sec  | tion is clas |  |
| Check compress   | sion - Sectior  | า 6.2.4                                     |          |                  |                                    |  |   |              |  |
| Design compress  | ion force   | N <sub>Ed</sub> = <b>22</b> kN              |          |                  | N <sub>Ed</sub> / N <sub>c,R</sub> |  |   |              |  |
|  |   |   |          | ~ ~              |                                    |  |   |              |  |
|  |   |   |          |                  |                                    | ssion resista                          | nce exceeds design  | compressi    |  |
| <b>Check y-y axis f</b><br>Design buckling r   |   | ing resistanc<br>N <sub>b,y,Rd</sub> = 868. | e - Sect |                  | .1                                 | ssion resista<br><sub>Rd</sub> = 0.025 | nce exceeds design  | compressi    |  |

|   | - <u>_</u>  |  |  |  |  |   |
|---|---|--|--|--|--|---|
| BAYLISS   | Project   |  |  |  | Job Ref.   |   |
| CONSULTING  |   | Willington   | Sport Pavillion  |  | -  | 000   |
| CONSOLTINO  | Section   | 01 1   |  |  | Sheet no./rev.   | <u></u>   |
| I and Structural Engineering Consultants  | Calc. by  | Date   | Calculations   | Date   |  | 36<br>Date  |
| 01332 292192  | TGB   | 01.06.23   |  | Jale   | App'd  | Date  |
|   | ТGВ   | 01.00.23   |  |  |  |   |
| Check z-z axis flexural buckl   | ing resistance -  | Section 6.3.1  | 1  |  |  |   |
| Design buckling resistance  | N <sub>b,z,Rd</sub> = <b>524.3</b> k  |  | N <sub>Ed</sub> / N <sub>b,z,Rd</sub> = 0.0  | 42   |  |   |
| 5 5   | _,_, _  |  | Design buckling i  |  | ceeds design   | compressio  |
| Check torsional and torsiona  | l-flexural buckli   | na resistance  | - Section 6 3 1 1  |  | _  | -   |
| Design buckling resistance  | N <sub>b,T,Rd</sub> = 671.8 k   | -  | N <sub>Ed</sub> / N <sub>b.T.Rd</sub> = 0.0  | 33   |  |   |
| 0   |   |  | Design buckling i  | resistance ex  | ceeds design   | compressi   |
| Check decign at start of oner   | -   |  |  |  | -  | -   |
| Check design at start of spar   | 1   |  |  |  |  |   |
| Check shear - Section 6.2.6   |   |  |  |  |  |   |
| Design shear force  | V <sub>y,Ed</sub> = <b>1.5</b> kN   |  | Design shear res   |  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4                                 | 4 KN  |
|   |   | DA   | $V_{y,Ed} / V_{pl,y,Rd} = 0$ .<br>SS - Design shea   |  | ovcoode dosia  | n choar for                                       |
|   |   | r A  | 55 - Design shea   | resistance   | exceeds design   | ii Shear Tur                                      |
| Check design at end of span   |   |  |  |  |  |   |
| Check shear - Section 6.2.6   |   |  |  |  |  |   |
| Design shear force  | V <sub>y,Ed</sub> = <b>1.5</b> kN   |  | Design shear res   |  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4                                 | 4 kN  |
|   |   |  | $V_{y,Ed} / V_{pl,y,Rd} = 0$   |  |  |   |
|   |   | PA   | SS - Design shea   | r resistance (   | exceeds desig  | n shear for                                       |
| Check bending moment - See  | ction 6.2.5   |  |  |  |  |   |
| Design bending moment   | M <sub>y,Ed</sub> = <b>4.6</b> kNm  |  | Bending resistan   |  | M <sub>c,y,Rd</sub> = <b>58.2</b>                                    | kNm   |
|   |   |  | $M_{y,Ed} / M_{c,y,Rd} = 0$  |  |  |   |
|   |   | · Design bena  | ling resistance m  | oment excee  | as aesign ben  | aing mome   |
| Check buckling resistance -   |   |  |  |  |  |   |
| Buckling resistance moment  | M <sub>b,y,Rd</sub> = 58.2 kN   |  | $M_{y,Ed} / M_{b,y,Rd} = 0$  |  | da daalaa kaa  |   |
|   |   | •  | ling resistance m  | oment excee  | as aesign ben  | aing mome   |
| Check bending and axial for   | :e - Section 6.2.9  |  |  |  |  |   |
| Maximum longitudinal stress   |   |  | Ed / W <sub>el.y</sub> + N <sub>Ed</sub> / A   | = <b>35</b> N/mm <sup>2</sup>  |  |   |
| Limiting longitudinal stress - Ec   | Į.6.42  |  | γ <sub>M0</sub> = <b>355</b> N/mm <sup>2</sup>   |  |  |   |
|   |   |  |  |  |  |   |
|   |   | σy,Ed / σy,lin   |  |  | 11   |   |
| Interaction formula or 6.2  |   | - Maximum k  | ongitudinal stress   | s is less than   | limiting longit  | udinal stre                                       |
| Interaction formula - eq.6.2  | PASS<br>N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,E</sub>  | - Maximum Io<br><sub>Ed</sub> / M <sub>c,y,Rd</sub> = 0.0  | ongitudinal stress<br>099  |  |  |   |
|   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,f</sub>  | - Maximum Ic<br><sub>Ed</sub> / M <sub>c,y,Rd</sub> = 0.0<br>PASS - Utilis   | ongitudinal stress<br>099<br>sation of combine   | ed bending a   |  |   |
| Interaction factors k <sub>ij</sub> for mer   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,E</sub>  | - Maximum Id<br><sub>Ed</sub> / M <sub>c.y.Rd</sub> = 0.0<br>PASS - Utilia<br>le to torsional  | ongitudinal stress<br>099<br>sation of combine   | ed bending a   |  |   |
|   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,f</sub>  | <i>Maximum Ic</i><br><sub>Ed</sub> / M <sub>c.y.Rd</sub> = 0.(<br><i>PASS - Utili</i><br>le to torsional<br>(6) = 0.126  | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T   | ed bending a<br>able B.2   | nd axial force   | is acceptab                                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,</sub><br>nbers susceptibl<br>max(0.076, 0.12  | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin  | ed bending a<br>able B.2   | nd axial force   | is acceptab                                       |
| Interaction factors k <sub>ij</sub> for mer   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,</sub><br>nbers susceptibl<br>max(0.076, 0.12  | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin  | ed bending a<br>able B.2   | nd axial force   | is acceptab                                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,F</sub><br>nbers susceptib<br>max(0.076, 0.12<br>D <u>G + 1.0ψ₀Q + 0.5</u>                                     | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin  | ed bending a<br>able B.2   | nd axial force   | is acceptab                                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u>  | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>DG + 1.0ψ₀Q + 0.5                                       | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin  | ed bending a<br>able B.2   | nd axial force   | is acceptab                                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u>  | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>DG + 1.0ψ₀Q + 0.5                                       | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin  | ed bending a<br>able B.2<br>g and compr                                  | nd axial force   | is acceptab<br>are satisfi                        |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u><br>Check y-y axis deflection - Se                              | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,F</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>0 <u>G + 1.0ψ₀Q + 0.5</u><br>ection 7.2.1              | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin<br>rvice)  | ed bending a<br>Table B.2<br>g and compr                                 | nd axial force i   | is acceptab<br>are satisfi                        |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u><br>Check y-y axis deflection - Se                              | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,F</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>0 <u>G + 1.0ψ₀Q + 0.5</u><br>ection 7.2.1              | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin<br>rvice)<br>Allowable deflect                           | ed bending a<br>Table B.2<br>g and compr<br>ion<br>257                   | nd axial force of<br>ression checks<br>δ <sub>y,Allowable</sub> = 10 | is acceptab<br>are satisfic                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u><br><u>Check y-y axis deflection - Se</u><br>Maximum deflection | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,F</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>0 <u>G + 1.0ψ₀Q + 0.5</u><br>ection 7.2.1              | Maximum Ic<br>- Maximum Ic | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin<br>rvice)<br>Allowable deflect<br>δy / δy,Allowable = 0. | ed bending a<br>Table B.2<br>g and compr<br>ion<br>257                   | nd axial force of<br>ression checks<br>δ <sub>y,Allowable</sub> = 10 | is acceptat<br>are satisfic                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u><br><u>Check y-y axis deflection - Se</u><br>Maximum deflection | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,f</sub><br>mbers susceptibl<br>max(0.076, 0.12<br>0G + 1.0ψ₀Q + 0.5<br>ection 7.2.1<br>δ <sub>y</sub> = 2.6 mm | e - Maximum Ic<br>=d / M <sub>c,y,Rd</sub> = 0.0<br>PASS - Utilia<br>le to torsional<br>(6) = 0.126<br>PASS - 0<br>5S + 1.0W (Set  | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin<br>rvice)<br>Allowable deflect<br>δy / δy,Allowable = 0. | ed bending a<br>Table B.2<br>g and compr<br>ion<br>257                   | nd axial force of<br>ression checks<br>δ <sub>y,Allowable</sub> = 10 | is acceptat<br>are satisfic                       |
| Interaction factors k <sub>ij</sub> for mer<br>Interaction formulae<br><u>Consider Combination 6 - 1.0</u><br><u>Check design at end of span</u><br><u>Check y-y axis deflection - Se</u><br>Maximum deflection | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M <sub>y,F</sub><br><b>nbers susceptib</b><br>max(0.076, 0.12<br>0 <u>G + 1.0ψ₀Q + 0.5</u><br>ection 7.2.1              | e - Maximum Ic<br>=d / M <sub>c,y,Rd</sub> = 0.0<br>PASS - Utilia<br>le to torsional<br>(6) = 0.126<br>PASS - 0<br>5S + 1.0W (Set  | ongitudinal stress<br>099<br>sation of combine<br>I deformations - T<br>Combined bendin<br>rvice)<br>Allowable deflect<br>δy / δy,Allowable = 0. | ed bending a<br>Table B.2<br>g and compr<br>ion<br>257<br>ble deflectior | nd axial force of<br>ression checks<br>δ <sub>y,Allowable</sub> = 10 | is acceptab<br>are satisfic<br>mm<br>gn deflectic |

|  | Project  |              |                |      | Job Ref.       |      |
|--|----------|--------------|----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion |      | 60             | 000  |
| CONSULTING                                   | Section  |              |                |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      | :              | 37   |
|  | Calc. by | Date         | Chk'd by       | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                |      |                |      |

| Column 2 results summa  | ry   | Unit     | Capacity  | Maximum   | Utilisation   | Result              |
|---|--|----------|---|---|---|---------------------|
| Shear resistance (y-y)  |  | kN       | 204.4   | 2.7   | 0.013   | PASS                |
| Bending resistance (y-y)  |  | kNm      | 58.2  | 8.1   | 0.140   | PASS                |
| Compression resistance  |  | kN       | 524.3   | 22.6  | 0.043   | PASS                |
| •   |  |          |   |   |   |                     |
| Comb. bending and axial   | force  |          |   |   | 0.193   | PASS                |
| Deflection (y-y)  |  | mm       | 10  | 3.0   | 0.301   | PASS                |
| Lateral restraint<br>Both flanges have lateral rest<br>Consider Combination 5 - 1<br>Classification of cross sect     | <u>.35G + 1.5ψ₀Q +</u>   | · 1.5ψ₀S | S + 1.5W (Strength  | <u>ı)</u>   |   |                     |
| Internal compression parts  | Class 1  |          | Outstar   | nd flanges  | Class 3   | ion is class        |
| Check compression - Section   | on 6.2.4   |          |   |   | Secu  | UN 13 CIASS         |
| Design compression force  | N <sub>Ed</sub> = <b>21.8</b> kN   |          | •   | resistance of section<br><sub>x,Rd</sub> = <b>0.021</b>   | N <sub>c,Rd</sub> = N <sub>pl,Rd</sub> =                | = <b>1038.2</b> kN  |
|   |  | PAS      | SS - Design comp  | ression resistance of   | exceeds design  | compressi           |
| Check y-y axis flexural buc   | -  |          |   | - 0.025   |   |                     |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 868.7  | KIN      |   | <sub>b,y,Rd</sub> = 0.025<br>buckling resistance e  | exceeds design (  | compressi           |
| Check z-z axis flexural bucl  | kling resistance   | - Secti  | on 6.3.1.1  | -   | -   |                     |
| Design buckling resistance  | N <sub>b,z,Rd</sub> = 524.3  |          |   | <sub>b,z,Rd</sub> = <b>0.042</b>  |   |                     |
|   |  |          | PASS - Design b   | ouckling resistance of  | exceeds design  | compressi           |
| Check torsional and torsion   |  | -        |   |   |   |                     |
| Design buckling resistance  | N <sub>b,T,Rd</sub> = 671.8  | 3 kN     |   | <sub>b,T,Rd</sub> = 0.032<br>buckling resistance o  | ovcoods dosian  | compressi           |
|   |  |          | Allo - Design b   | acking resistance   |   | Compression         |
|   |  |          |   |   |   |                     |
| Check design at start of spa  |  |          |   |   |   |                     |
| Check shear - Section 6.2.6   |  |          | Desian  | shear resistance  | Vply Rd = 204 4   | l kN                |
| Check shear - Section 6.2.6   |  |          | 0   | shear resistance<br>/pl.y.Rd = <b>0.013</b>   | V <sub>pl,y,Rd</sub> = <b>204.4</b>                     | l kN                |
| Check shear - Section 6.2.6   |  |          | V <sub>y,Ed</sub> / V   |   |   |                     |
| Check shear - Section 6.2.6<br>Design shear force   | V <sub>y,Ed</sub> = <b>2.7</b> kN  |          | V <sub>y,Ed</sub> / V   | / <sub>pl,y,Rd</sub> = <b>0.013</b>   |   |                     |
|   | V <sub>y,Ed</sub> = 2.7 kN<br><u>n</u>   |          | V <sub>y,Ed</sub> / V   | / <sub>pl,y,Rd</sub> = <b>0.013</b>   |   |                     |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6 | V <sub>y,Ed</sub> = 2.7 kN<br><u>n</u>   |          | V <sub>y,Ed</sub> / ∨<br><b>PASS - Des</b><br>Design                          | γ <sub>pl,y,Rd</sub> <b>= 0.013</b><br><i>ign shear resistance</i><br>shear resistance                          |   | n shear for         |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6 | V <sub>y,Ed</sub> = <b>2.7</b> kN<br><u>n</u>                                      |          | V <sub>y,Ed</sub> / V<br><b>PASS - Des</b><br>Design<br>V <sub>y,Ed</sub> / V | / <sub>pl.y.Rd</sub> = 0.013<br>ign shear resistance  | e exceeds design<br>V <sub>pl,y,Rd</sub> = <b>204.4</b> | n shear for<br>I kN |
| Check shear - Section 6.2.6<br>Design shear force<br>Check design at end of spa                                       | V <sub>y,Ed</sub> = <b>2.7</b> kN<br><u>n</u><br>V <sub>y,Ed</sub> = <b>2.7</b> kN |          | V <sub>y,Ed</sub> / V<br><b>PASS - Des</b><br>Design<br>V <sub>y,Ed</sub> / V | Y <sub>pl,y,Rd</sub> = 0.013<br><i>ign shear resistance</i><br>shear resistance<br>Y <sub>pl,y,Rd</sub> = 0.013 | e exceeds design<br>V <sub>pl,y,Rd</sub> = <b>204.4</b> | n shear for<br>I kN |

|   | Project  |                     | /illim+                                  |   |   | Job Ref.  | 6000  |
|---|--|---------------------|--|---|---|---|---|
| BAYLISS<br>CONSULTING   |  | W                   | /illington \$                            | Sport Pavilli   | on  |   | 6000  |
| CONSOLTINO  | Section  |                     |  | <b>0</b> 1 1 1  |   | Sheet no./rev.  | 00  |
| and Structural Engineering Consultants  |  |                     | Structural                               | Calculation   |   |   | 38  |
| 01332 292192  | Calc. by   | Date                |  | Chk'd by  | Date  | App'd   | Date  |
|   | TGB  | 01                  | .06.23                                   |   |   |   |   |
|   |  |                     |  | M <sub>y,Ed</sub> / M <sub>c,</sub>   | / Rd = 0.14   |   |   |
|   | PASS   | - Des               | ian bend                                 | -   |   | xceeds design be  | ndina mon   |
| <b>A</b>  |  | Dee                 | ign bena                                 | ing resista   |   | xuccuu ucoigii be   | nanng mon   |
| Check buckling resistance - S   |  |                     |  |   |   |   |   |
| Buckling resistance moment  | M <sub>b,y,Rd</sub> = 58.2 kN  |                     |  | My,Ed / Mb,   |   |   |   |
|   | PA33 -   | Desi                | дп бискі                                 | ing resista   | nce moment e  | xceeds design be  | naing mon   |
| Check bending and axial forc  | e - Section 6.2.9  | Ð                   |  |   |   |   |   |
| Maximum longitudinal stress   |  | σ                   | $\sigma_{y,Ed} = M_{y,I}$                | <sub>Ed</sub> / W <sub>el.y</sub> + №   | N <sub>Ed</sub> / A = <b>57</b> N/m   | 1m²   |   |
| Limiting longitudinal stress - Eq   | .6.42  | σ                   | $\sigma_{y,lim} = f_y /$                 | <sub>γM0</sub> = <b>355</b> N   | /mm²  |   |   |
|   |  | σ                   | $\sigma_{ m y,Ed}$ / $\sigma_{ m y,lim}$ | n <b>= 0.16</b>   |   |   |   |
|   | PASS   | 6 - Ma              | ximum lo                                 | ongitudinal   | stress is less  | than limiting long  | itudinal str  |
| Interaction formula - eq.6.2  | $N_{Ed} / N_{c,Rd} + M_{y,R}$  | <sub>Ed</sub> / M   | <sub>c,y,Rd</sub> = <b>0.1</b>           | 6   |   |   |   |
|   |  | PAS                 | SS - Utilis                              | sation of co  | ombined bend  | ing and axial force   | e is accepta  |
| Interaction factors kij for men   | nbers susceptib  | le to t             | torsional                                | deformatio  | ons - Table B.2   | 2   |   |
| Interaction formulae  | max(0.117, 0.19  |                     |  |   |   |   |   |
|   |  | -                   |  | Combined L  | pending and co  | ompression check  | s are satis   |
|   |  |                     |  |   | -   |   |   |
| Consider Combination 6 - 1.0  | $G + 1.0\psi_0 Q + 0.5$  | 55 + 1              | I.UW (Ser                                | <u>VICe)</u>  |   |   |   |
| Check design 2301 mm along  | span   |                     |  |   |   |   |   |
| Check y-y axis deflection - Se  | ection 7.2.1   |                     |  |   |   |   |   |
| Maximum deflection  |  |                     |  |   |   |   |   |
|   | $o_V = 3$ (1)(1)   |                     |  | Allowable   | deflection  | $\delta_{v,Allowable} = 1$  | <b>0</b> mm   |
|   | δ <sub>y</sub> = <b>3</b> mm   |                     |  | Allowable<br>δy / δy Allowa   |   | $\delta_{y,Allowable} = 1$  | <b>0</b> mm   |
|   | oy = <b>3</b> mm   |                     |  | $\delta_{ m y}$ / $\delta_{ m y,Allowa}$  | able = 0.301  |   |   |
|   | oy = <b>3</b> mm   |                     |  | $\delta_{ m y}$ / $\delta_{ m y,Allowa}$  | able = 0.301  | δ <sub>y,Allowable</sub> = 1  |   |
| Beam 1 design   |  |                     |  | $\delta_{ m y}$ / $\delta_{ m y,Allowa}$  | able = 0.301  |   |   |
| <u>Beam 1 design</u><br>Section details   | UB 254x146x31  | (BS4                | <b>⊦-1)</b>                              | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A                                  | <sub>able</sub> = 0.301<br>Allowable defle  | ction exceeds des   | sign deflec   |
| <u>Beam 1 design</u><br>Section details<br>Steel grade  | UB 254x146x31<br>S355  | (BS4                | I-1)                                     | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c              | able = 0.301<br>Mowable defle   | ection exceeds des<br>E = 210000  | sign deflec   |
| <u>Beam 1 design</u><br>Section details   | UB 254x146x31  | (BS4                | I-1)                                     | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c              | <sub>able</sub> = 0.301<br>Allowable defle  | ection exceeds des<br>E = 210000  | sign deflec   |
| <u>Beam 1 design</u><br>Section details<br>Steel grade  | UB 254x146x31<br>S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup>                   | (BS4                | -1)<br>Capaci                            | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c<br>Nominal u | able = 0.301<br>Mowable defle   | ection exceeds des<br>E = 210000  | sign deflec<br>N/mm²<br>1m²   |
| <u>Beam 1 design</u><br>Section details<br>Steel grade<br>Nominal yield strength  | UB 254x146x31<br>S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup>                   | nit                 |  | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c<br>Nominal u | able = 0.301<br>Allowable defie<br>of elasticity<br>It.tensile streng   | E = <b>210000</b><br>th f <sub>u</sub> = <b>470</b> N/m   | n/mm <sup>2</sup>   |
| Beam 1 design<br>Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary<br>Shear resistance (γ-γ)   | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup>                               | nit                 | <b>Capaci</b><br>335.5                   | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c<br>Nominal u | able = 0.301<br><i>llowable defle</i><br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1                       | E = 210000<br>th $f_u = 470 \text{ N/m}$<br>Utilisation<br>0.021  | N/mm <sup>2</sup><br>m <sup>2</sup><br>Resul  |
| Beam 1 design<br>Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary   | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup>                               | nit                 | Capaci                                   | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c<br>Nominal u | able = 0.301<br>Ilowable defie<br>of elasticity<br>It.tensile streng<br>Maximum                                     | E = 210000<br>th $f_u = 470 \text{ N/m}$<br>Utilisation   | N/mm <sup>2</sup><br>m <sup>2</sup><br>Resu   |
| Beam 1 design<br>Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary<br>Shear resistance (γ-γ)   | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup>                               | nit<br>N            | <b>Capaci</b><br>335.5                   | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br><b>PASS - A</b><br>Modulus c<br>Nominal u | able = 0.301<br><i>llowable defle</i><br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1                       | E = 210000<br>th $f_u = 470 \text{ N/m}$<br>Utilisation<br>0.021  | n/mm <sup>2</sup><br>Resu<br>PASS   |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)   | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Ui<br>kN<br>kN<br>kN       | nit<br>N            | <b>Capaci</b><br>335.5<br>41.8           | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = <b>0.301</b><br><i>Ilowable defle</i><br>of elasticity<br>It.tensile streng<br><b>Maximum</b><br>7.1<br>11.2 | E = 210000<br>th $f_u = 470 \text{ N/m}$<br>Utilisation<br>0.021<br>0.268   | n/mm²<br>m²<br>Resul<br>PASS<br>PASS  |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)Compression resistanceComb. bending and axial for                | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Uf<br>kN<br>kN<br>rce      | nit<br>N<br>Nm<br>N | Capaci<br>335.5<br>41.8<br>121.5         | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = 0.301<br>Mowable defie<br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1<br>11.2<br>2.7                | E = 210000         th $f_u = 470 \text{ N/m}$ Utilisation         0.021         0.268         0.022         0.289 | sign deflec<br>N/mm <sup>2</sup><br>m <sup>2</sup><br>Resul<br>PASS<br>PASS<br>PASS<br>PASS |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)Compression resistance   | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Uf<br>kN<br>kN<br>rce      | nit<br>N            | <b>Capaci</b><br>335.5<br>41.8           | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = <b>0.301</b><br><i>Ilowable defle</i><br>of elasticity<br>It.tensile streng<br><b>Maximum</b><br>7.1<br>11.2 | E = 210000<br>th f <sub>u</sub> = 470 N/m<br>0.021<br>0.268<br>0.022  | sign deflec<br>N/mm <sup>2</sup><br>m <sup>2</sup><br>Resul<br>PASS<br>PASS<br>PASS         |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)Compression resistanceComb. bending and axial for                | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Uf<br>kN<br>kN<br>rce      | nit<br>N<br>Nm<br>N | Capaci<br>335.5<br>41.8<br>121.5         | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = 0.301<br>Mowable defie<br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1<br>11.2<br>2.7                | E = 210000         th $f_u = 470 \text{ N/m}$ Utilisation         0.021         0.268         0.022         0.289 | sign deflec<br>N/mm <sup>2</sup><br>m <sup>2</sup><br>Resul<br>PASS<br>PASS<br>PASS         |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)Compression resistanceComb. bending and axial for                | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Uf<br>kN<br>kN<br>rce      | nit<br>N<br>Nm<br>N | Capaci<br>335.5<br>41.8<br>121.5         | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = 0.301<br>Mowable defie<br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1<br>11.2<br>2.7                | E = 210000         th $f_u = 470 \text{ N/m}$ Utilisation         0.021         0.268         0.022         0.289 | n/mm²<br>m²<br>Resul<br>PASS<br>PASS  |
| Beam 1 designSection detailsSteel gradeNominal yield strengthBeam 1 results summaryShear resistance (y-y)Bending resistance (y-y)Compression resistanceComb. bending and axial foDeflection (y-y) | UB 254x146x31<br>S355<br>fy = <b>355</b> N/mm <sup>2</sup><br>Uf<br>kN<br>kN<br>rce<br>m | nit<br>N<br>Nm<br>N | Capaci<br>335.5<br>41.8<br>121.5         | δ <sub>y</sub> / δ <sub>y,Allowa</sub><br>PASS - A<br>Modulus c<br>Nominal u        | able = 0.301<br>Mowable defie<br>of elasticity<br>It.tensile streng<br>Maximum<br>7.1<br>11.2<br>2.7                | E = 210000         th $f_u = 470 \text{ N/m}$ Utilisation         0.021         0.268         0.022         0.289 | sign deflec<br>N/mm <sup>2</sup><br>m <sup>2</sup><br>Resul<br>PASS<br>PASS<br>PASS         |

Classification of cross sections - Section 5.5 Internal compression parts Class 1

Outstand flanges

Class 1 Section is class 1

|   | Project                              |   |   |                                  | Job Ref.                         |                                  |
|---|--------------------------------------|---|---|----------------------------------|----------------------------------|----------------------------------|
| BAYLISS   | Project                              | Willington S                                  | Sport Pavillion   |                                  |                                  | 6000                             |
| CONSULTING  | Section                              |   |   |                                  | Sheet no./rev.                   |                                  |
| I and Structural Engineering Consultants                            |                                      | Structural                                    | Calculations  |                                  |                                  | 39                               |
| 01332 292192  | Calc. by                             | Date  | Chk'd by  | Date                             | App'd                            | Date                             |
|   | TGB                                  | 01.06.23                                      |   |                                  |                                  |                                  |
|   |                                      |   |   |                                  |                                  |                                  |
| Check compression - Section   |                                      |   |   |                                  |                                  |                                  |
| Design compression force  | N <sub>Ed</sub> = <b>2.7</b> kN      |   | 0   | ance of section                  | $N_{c,Rd} = N_{pl,Rd}$           | = <b>1038.2</b> kN               |
|   |                                      |   | $N_{Ed} / N_{c,Rd} = 0$                                   |                                  |                                  |                                  |
|   |                                      | PASS - Desig                                  | gn compressio   | on resistance e                  | xceeas aesign                    | i compressi                      |
| Check y-y axis flexural buckl                                       | -                                    |   |   |                                  |                                  |                                  |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 908 kN         |   | $N_{Ed} / N_{b,y,Rd} =$                                   |                                  |                                  |                                  |
|   |                                      | PASS - I                                      | Jesign bucklii  | ng resistance e                  | xceeds design                    | i compressi                      |
| Check z-z axis flexural buckli                                      | •                                    |   | l   |                                  |                                  |                                  |
| Design buckling resistance  | N <sub>b,z,Rd</sub> = <b>121.5</b>   |   | $N_{Ed} / N_{b,z,Rd} =$                                   |                                  |                                  |                                  |
|   |                                      | PASS - I                                      | Design bucklii  | ng resistance e.                 | xceeds design                    | n compressi                      |
| Check torsional and torsiona  | I-flexural buckli                    | ing resistance                                | - Section 6.3.  | 1.1                              |                                  |                                  |
| Design buckling resistance  | N <sub>b,T,Rd</sub> = 541.7          | ٨N  | $N_{Ed} / N_{b,T,Rd} =$                                   | 0.005                            |                                  |                                  |
|   |                                      | PASS - I                                      | Design bucklii  | ng resistance e                  | xceeds design                    | n compressi                      |
| Check design 3935 mm along  | <u>span</u>                          |   |   |                                  |                                  |                                  |
| Check bending moment - Sec  | tion 6 2 5                           |   |   |                                  |                                  |                                  |
| Design bending moment   | M <sub>y,Ed</sub> = <b>11.2</b> kN   | m   | Bendina resis   | stance moment                    | M <sub>c,y,Rd</sub> = <b>139</b> | . <b>5</b> kNm                   |
| Doolgh bonaing momon  | iniy,Eu                              |   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>                   |                                  | 100,y,10                         |                                  |
|   | PASS                                 | - Desian bend                                 |   | e moment excee                   | eds desian bei                   | ndina mome                       |
| Check buckling resistance - S                                       |                                      | 0   | 0   |                                  | U                                | U                                |
| Buckling resistance moment  | M <sub>b,y,Rd</sub> = <b>41.8</b> kl | Nm  | M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>                   | = 0.268                          |                                  |                                  |
|   | -                                    |   |   | e moment excee                   | eds desian bei                   | ndina mome                       |
| Check bending and axial force                                       |                                      | -   | 0   |                                  | U                                | U                                |
| Bending and axial force check                                       |                                      |   | $N_{Ed} / N_{V,lim} = 0$                                  | 0 019                            |                                  |                                  |
| Allowance need not be ma  |                                      |   | 2   |                                  | e moment abo                     | ut the v-v a                     |
|   |                                      |   | -   |                                  |                                  | ,,,                              |
| Interaction factors k <sub>ij</sub> for men<br>Interaction formulae | max(0.248, 0.28                      |   | deformations  | 5 - Table B.2                    |                                  |                                  |
|   | max(0.240, 0.20                      | •   | ombined ben   | ding and comp                    | ression check                    | e aro eatisfi                    |
|   |                                      | 7 400 - 0                                     | ombilica beli   | ang ana comp                     |                                  | S are Satish                     |
| Check design at end of span   |                                      |   |   |                                  |                                  |                                  |
| Check shear - Section 6.2.6   |                                      |   |   |                                  |                                  |                                  |
| Design shear force  | V <sub>y,Ed</sub> = <b>7.1</b> kN    |   | Design shear<br>V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> = |                                  | $V_{c,y,Rd} = V_{pl,y}$          | <sub>,Rd</sub> = <b>204.4</b> ki |
|   |                                      | PAS   |   | hear resistance                  | exceeds desig                    | gn shear for                     |
| Check bending moment - Sec  | tion 6.2.5                           |   | -   |                                  |                                  |                                  |
| Design bending moment   | M <sub>y,Ed</sub> = <b>8.1</b> kNm   | ı   | -   | stance moment                    | Mc,y,Rd = <b>139</b>             | .5 kNm                           |
|   | <b>D</b> 400                         | Dealers have 1                                | My,Ed / Mc,y,Rd   |                                  | do doniero bi                    | ndine                            |
|   |                                      | - Design bend                                 | ing resistance  | e moment excee                   | eus uesign Dei                   | nung mome                        |
| Check buckling resistance - S                                       |                                      |   |   | <b>a</b> 46-                     |                                  |                                  |
|   | M <sub>b,y,Rd</sub> = <b>41.8</b> kl |   | My,Ed / Mb,y,Rd   |                                  | de destrat                       |                                  |
| Buckling resistance moment  | 2280                                 | - Design buckl                                | ing resistance  | e moment excee                   | eas aesign bei                   | naing mome                       |
| Buckling resistance moment  | 1 400                                | •   |   |                                  |                                  |                                  |
| Interaction factors k <sub>ij</sub> for men                         | nbers susceptik                      | ole to torsional                              | deformations  | s - Table B.2                    |                                  |                                  |
| -   |                                      | <b>ble to torsional</b><br>16) = <b>0.216</b> |   | s - Table B.2<br>Inding and comp |                                  |                                  |

|  | Project  |              |                |      | Job Ref.       |      |
|--|----------|--------------|----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion |      | 60             | 000  |
| CONSULTING                                   | Section  |              |                |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      |                | 40   |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                |      |                |      |

#### Consider Combination 6 - 1.0G + 1.0w0Q + 0.5S + 1.0W (Service)

#### Check design 4020 mm along span

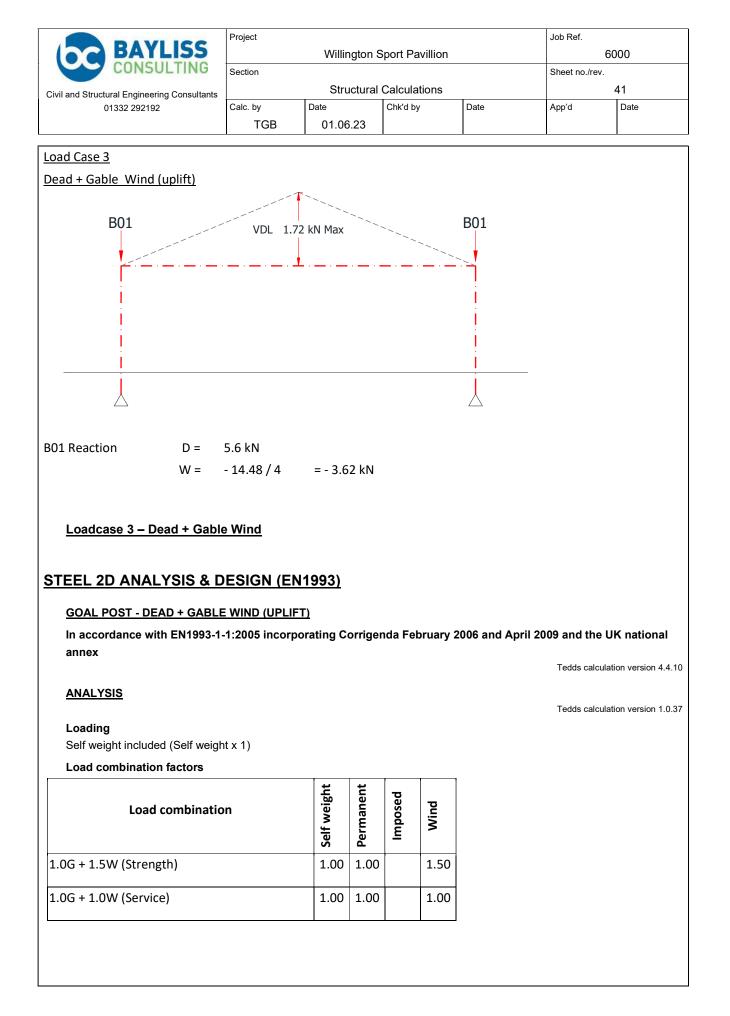
Check y-y axis deflection - Section 7.2.1

Maximum deflection  $\delta_y$  = 5.6 mm

Allowable deflection  $\delta_y / \delta_{y,Allowable} = 0.243$ 

 $\delta_{y,Allowable}$  = 23.1 mm

PASS - Allowable deflection exceeds design deflection

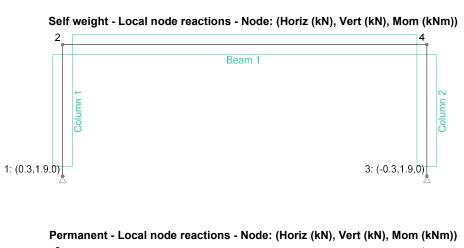


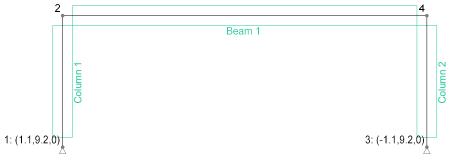
|  | Project  |              |                |      | Job Ref.       |      |
|--|----------|--------------|----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion |      | 60             | 00   |
| CONSULTING                                   | Section  |              |                |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      |                | 42   |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                |      |                |      |

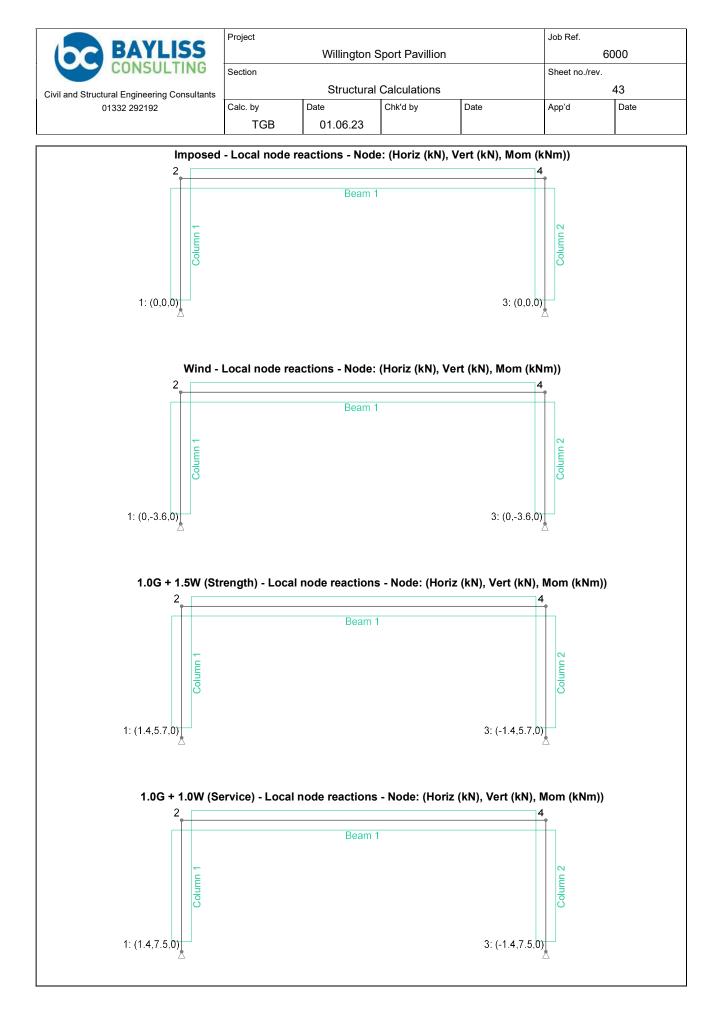
| Member Loads |           |            |             |  |
|--------------|-----------|------------|-------------|--|
| Member       | Load case | Load Type  | Orientation | Description                            |
| Beam 1       | Permanent | VDL        | GlobalZ     | 0 kN/m at 0 m to 1.72 kN/m at 4.15 m   |
| Beam 1       | Permanent | VDL        | GlobalZ     | 1.72 kN/m at 4.15 m to 0 kN/m at 8.3 m |
| Column 1     | Permanent | Point load | GlobalZ     | 5.6 kN at 3 m                          |
| Column 2     | Permanent | Point load | GlobalZ     | 5.6 kN at 3 m                          |
| Column 1     | Wind      | Point load | GlobalZ     | -3.62 kN at 3 m                        |
| Column 2     | Wind      | Point load | GlobalZ     | -3.62 kN at 3 m                        |

### <u>Results</u>

Reactions







|  | Project  |              |                |      | Job Ref.       |      |
|--|----------|--------------|----------------|------|----------------|------|
| BAYLISS                                      |          | Willington S | port Pavillion |      | 60             | 000  |
| CONSULTING                                   | Section  |              |                |      | Sheet no./rev. |      |
| Civil and Structural Engineering Consultants |          | Structural   | Calculations   |      |                | 44   |
| 01332 292192                                 | Calc. by | Date         | Chk'd by       | Date | App'd          | Date |
|  | TGB      | 01.06.23     |                |      |                |      |

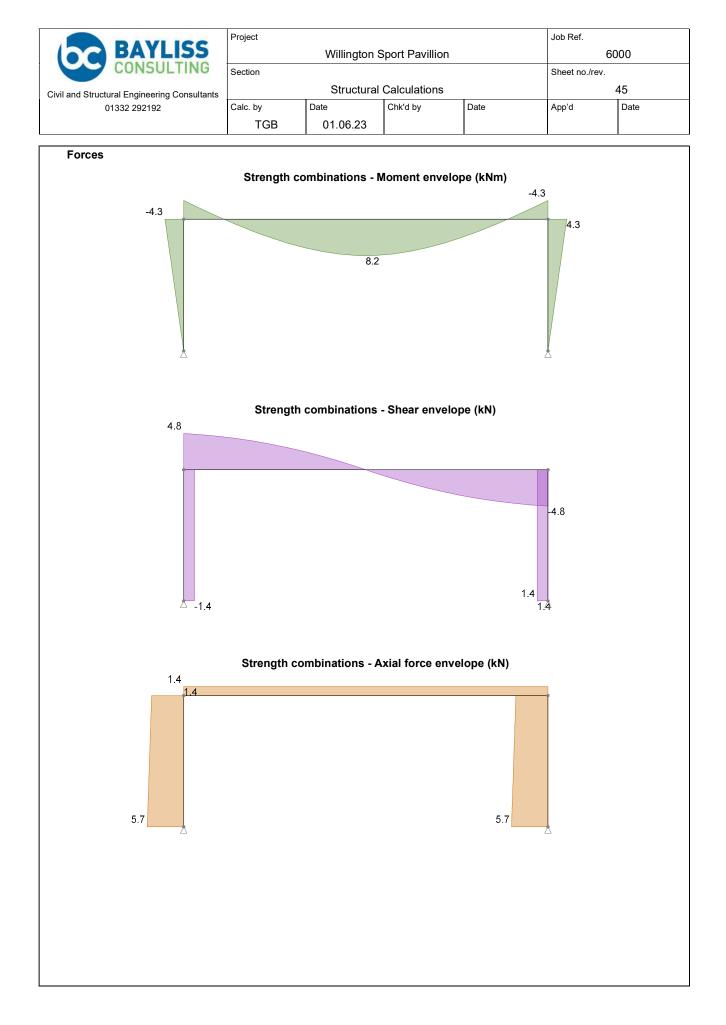
#### **Element end forces**

#### Load combination: 1.0G + 1.5W (Strength)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -5.7        | 1.4         | 0      |
|         |        | 2         | 4.8         | -1.4        | -4.3   |
| 2       | 3      | 3         | -5.7        | -1.4        | 0      |
|         |        | 4         | 4.8         | 1.4         | 4.3    |
| 3       | 8.3    | 2         | -1.4        | -4.8        | 4.3    |
|         |        | 4         | 1.4         | -4.8        | -4.3   |

### Load combination: 1.0G + 1.0W (Service)

| Element | Length | Nodes     | Axial force | Shear force | Moment |
|---------|--------|-----------|-------------|-------------|--------|
|         | (m)    | Start/End | (kN)        | (kN)        | (kNm)  |
| 1       | 3      | 1         | -7.5        | 1.4         | 0      |
|         |        | 2         | 4.8         | -1.4        | -4.3   |
| 2       | 3      | 3         | -7.5        | -1.4        | 0      |
|         |        | 4         | 4.8         | 1.4         | 4.3    |
| 3       | 8.3    | 2         | -1.4        | -4.8        | 4.3    |
|         |        | 4         | 1.4         | -4.8        | -4.3   |



| DA DA  | YLISS   | Project   | v   | Villington  | Sport Pavill                           | ion  |  | Job Ref.   | 6000  |
|--|---|---|---|---|--|--|--|--|---|
| CON  | SULTING   | Section   |   | <b>U</b>  |  |  |  | Sheet no./rev.   |   |
| and Structural Engine  | ering Consultants   |   |   | Structura   | al Calculation                         | ns   |  |  | 46  |
| 01332 292  |   | Calc. by  | Date  |   | Chk'd by                               |  | Date   | App'd  | Date  |
|  |   | TGB   | 0   | 1.06.23   |  |  |  |  |   |
| Member results   | ;   |   |   |   |  |  |  |  |   |
| Envelope - Serv  | vice combinat   |   |   |   |  |  | 1  |  |   |
| Member   |   | De  | eflectio  | n   |  |  |  |  |   |
|  | Pos   | Max   |   | Pos   | Min                                    |  |  |  |   |
|  | (m)   | (mm)  |   | (m)   | (mm)                                   |  |  |  |   |
| Column 1   | 3   | 0   | 1   | 1.73  | -0.9 (mi                               | n)   |  |  |   |
| Column 2   | 1.73  | 0.9   |   | 3   | 0                                      |  |  |  |   |
| Beam 1   | 4.15  | 5.6 (max)   |   | 0   | 0                                      |  |  |  |   |
| Partial factors -  | Section 6.1   | γ <sub>M0</sub> = <b>1</b>  | I   |   | γ <sub>M1</sub> = <b>1</b>             |  | J  | γ <sub>M2</sub> = <b>1.1</b>   |   |
| Column 1 desig   | ın  |   |   |   |  |  |  |  |   |
| Section details  |   | UC 152x152  | x23 (BS4  | 4-1)  |  |  |  |  |   |
| Steel grade  |   | S355  | ,   | ,   | Modulus                                | of ela   | sticity  | E = 210000   | N/mm <sup>2</sup>   |
| -  | onath   | f <sub>y</sub> = <b>355</b> N/mi  | 2   |   |  |  | -  |  |   |
| Nominal yield str  | engin   | ly - 355 N/III  | n-  |   | Nominal u                              | ult.ten  | sile strength                                  | f <sub>u</sub> = <b>470</b> N/m  | 1m²   |
| Nominal yield sti  | engin   | iy – 355 N/III  | n-  |   | Nominal (                              | ult.ten  | sile strength                                  | f <sub>u</sub> = <b>470</b> N/m  | 1m²   |
| Column 1 resu  |   |   | Unit  | Сарас   |  | T  | nsile strength<br><b>ximum</b>                 | f <sub>u</sub> = 470 N/m   |   |
| -  | ults summary  |   | 1   | <b>Capac</b><br>204.4                                 |  | T  |  |  |   |
| Column 1 resu  | ults summary  |   | Unit  |   |  | Max  |  | Utilisation  | Resul   |
| Column 1 resu  | ults summary<br>ce (y-y)<br>ance (y-y)  |   | <b>Unit</b><br>kN   | 204.4   |  | <b>Ma</b><br>1.4   |  | Utilisation<br>0.007   | <b>Resul</b><br>PASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist  | ults summary<br>ice (y-y)<br>cance (y-y)<br>resistance  | /   | Unit<br>kN<br>kNm   | 204.4<br>58.2   |  | <b>Max</b><br>1.4<br>4.3   |  | <b>Utilisation</b><br>0.007<br>0.073   | PASS<br>PASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression   | ults summary<br>ce (y-y)<br>ance (y-y)<br>resistance<br>g and axial fo  | /   | Unit<br>kN<br>kNm   | 204.4<br>58.2   |  | <b>Max</b><br>1.4<br>4.3   |  | Utilisation<br>0.007<br>0.073<br>0.011   | ResultPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin   | ults summary<br>ce (y-y)<br>ance (y-y)<br>resistance<br>g and axial fo  | /   | Unit<br>kN<br>kNm<br>kN   | 204.4<br>58.2<br>524.3                                |  | Max<br>1.4<br>4.3<br>5.7   |  | Utilisation<br>0.007<br>0.073<br>0.011<br>0.090  | ResultPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y  | ults summary<br>ice (y-y)<br>ance (y-y)<br>resistance<br>g and axial fo<br>y)   | brce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                |  | Max<br>1.4<br>4.3<br>5.7   |  | Utilisation<br>0.007<br>0.073<br>0.011<br>0.090  | ResultPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav  | ults summary<br>ice (y-y)<br>cance (y-y)<br>resistance<br>g and axial for<br>y)<br>t<br>t<br>ye lateral restra  | prce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                |  | Max<br>1.4<br>4.3<br>5.7   |  | Utilisation<br>0.007<br>0.073<br>0.011<br>0.090  | ResultPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav<br>Classification o  | ults summary<br>ce (y-y)<br>cance (y-y)<br>resistance<br>g and axial fo<br>y)<br>t<br>t<br>ve lateral restra  | prce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                | ity                                    | Max<br>1.4<br>4.3<br>5.7   | ximum  | Utilisation           0.007           0.073           0.011           0.090           0.093                          | ResultPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav  | ults summary<br>ce (y-y)<br>cance (y-y)<br>resistance<br>g and axial fo<br>y)<br>t<br>t<br>ve lateral restra  | prce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                |  | Max<br>1.4<br>4.3<br>5.7   | ximum  | Utilisation 0.007 0.073 0.011 0.090 0.093 Class 3  | ResultPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav<br>Classification o  | ults summary<br>ice (y-y)<br>cance (y-y)<br>resistance<br>g and axial for<br>y)<br>t<br>t<br>ve lateral restra<br>of cross section<br>asion parts                                 | orce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                | ity                                    | Max<br>1.4<br>4.3<br>5.7   | ximum  | Utilisation 0.007 0.073 0.011 0.090 0.093 Class 3  | ResultPASSPASSPASSPASSPASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav<br>Classification o<br>Internal compress   | ults summary<br>ce (y-y)<br>cance (y-y)<br>resistance<br>g and axial fo<br>y)<br>t<br>t<br>ve lateral restra<br>of cross sections<br>ssion parts<br>ssion - Section               | orce  | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3                                | Outstand                               | Max           1.4           4.3           5.7           0.9           flang  | es   | Utilisation 0.007 0.073 0.011 0.090 0.093 Class 3  | Result         PASS   |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression f<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav<br>Classification o<br>Internal compress   | ults summary<br>ce (y-y)<br>cance (y-y)<br>resistance<br>g and axial fo<br>y)<br>t<br>t<br>ve lateral restra<br>of cross sections<br>ssion parts<br>ssion - Section               | Drce<br>aint at supports<br>ons - Section<br>Class 1<br>n 6.2.4                             | Unit<br>kN<br>kNm<br>kN<br>mm                                     | 204.4<br>58.2<br>524.3<br>10                          | Design re<br>NEd / Nc,R                | Max           1.4           4.3           5.7           0.9           flang           sistar           d = 0.0   | es<br>nce of section<br>005                    | Utilisation 0.007 0.073 0.011 0.090 0.093 Class 3 Sec  | Result         PASS  |
| Column 1 results<br>Shear resistant<br>Bending resist<br>Compression of<br>Comb. bendint<br>Deflection (y-y)<br>Lateral restraint<br>Both flanges hav<br>Classification of<br>Internal compress<br>Design compress<br>Check y-y axis | ults summary<br>ice (y-y)<br>ance (y-y)<br>resistance<br>g and axial for<br>y)<br>t<br>t<br>re lateral restra<br>of cross section<br>asion parts<br>asion - Section<br>sion force | orce<br>aint at supports<br>ons - Section<br>Class 1<br>n 6.2.4<br>N <sub>Ed</sub> = 5.7 kN | Unit<br>kN<br>kNm<br>kN<br>mm<br>s only<br>5.5<br>PA:<br>e - Sect | 204.4<br>58.2<br>524.3<br>10                          | Design re<br>NEd / Nc,Ri<br>ign compre | Max           1.4           4.3           5.7           0.9           flang           esistar           d = 0.           ession                                    | es<br>nce of section<br>005<br>n resistance of | Utilisation<br>0.007<br>0.073<br>0.011<br>0.090<br>0.093<br>Class 3<br>Sec<br>N <sub>c,Rd</sub> = N <sub>pl,Rd</sub> | Result         PASS  |
| Column 1 resu<br>Shear resistan<br>Bending resist<br>Compression f<br>Comb. bendin<br>Deflection (y-y<br>Lateral restrain<br>Both flanges hav<br>Classification of<br>Internal compress<br>Design compress                           | ults summary<br>ice (y-y)<br>ance (y-y)<br>resistance<br>g and axial for<br>y)<br>t<br>t<br>re lateral restra<br>of cross section<br>asion parts<br>asion - Section<br>sion force | orce<br>aint at supports<br>ons - Section<br>Class 1<br>n 6.2.4<br>N <sub>Ed</sub> = 5.7 kN | Unit<br>kN<br>kNm<br>kN<br>mm<br>s only<br>5.5<br>PA:<br>e - Sect | 204.4<br>58.2<br>524.3<br>10<br>SS - Des<br>ion 6.3.1 | Design re<br>NEd / Nc,R<br>ign compre  | Max           1.4           4.3           5.7           0.9           flang           sistar           d = 0.           essistar           d = 0.           Rd = 0 | es<br>nce of section<br>005<br>n resistance of | Utilisation<br>0.007<br>0.073<br>0.011<br>0.090<br>0.093<br>Class 3<br>Sec<br>N <sub>c,Rd</sub> = N <sub>pl,Rd</sub> | Result         PASS         PASS |

|  | <u> </u>  |  |  |   |  |                 |
|--|---|--|--|---|--|-----------------|
| BAYLISS  | Project   |  |  |   | Job Ref.   |                 |
| CONSULTING   |   | Willington                                       | Sport Pavillio                                     | n   |  | 6000            |
| CONSOLITINO  | Section   | Structural                                       | Calculations                                       |   | Sheet no./rev  | . 47            |
| and Structural Engineering Consultants 01332 292192  | Calc by Dat   | Calc. by Date Chk'd by Date                      |  |   |  |                 |
| 01332 292192   | -   | e<br>01.06.23                                    | Clik d by  | Date  | App'd  | Date            |
|  | 100   | 51.00.20   |  |   |  |                 |
| Check z-z axis flexural buckli                       | ing resistance - Sec  | tion 6.3.1.                                      | 1  |   |  |                 |
| Design buckling resistance                           | N <sub>b,z,Rd</sub> = <b>524.3</b> kN                                     |  | N <sub>Ed</sub> / N <sub>b,z,Rd</sub>              | = 0.011   |  |                 |
|  |   | PASS -   | Design buck  | ling resistance e                               | xceeds desig   | n compressio    |
| Check torsional and torsiona                         | I-flexural buckling   | resistance                                       | - Section 6.3                                      | 3.1.1   |  |                 |
| Design buckling resistance                           | N <sub>b,T,Rd</sub> = 671.8 kN  |  | NEd / Nb,T,Rd                                      |   |  |                 |
|  |   | PASS -   | Design buck  | ling resistance e                               | xceeds desig   | n compressio    |
| Check design at start of spar                        | <b>1</b>  |  |  |   |  |                 |
|  | <u>-</u>  |  |  |   |  |                 |
| Check shear - Section 6.2.6                          |   |  | Design sha   |   | ) /  | 4 4 1.51        |
| Design shear force                                   | V <sub>y,Ed</sub> = <b>1.4</b> kN   |  | 0  | ar resistance                                   | V <sub>pl,y,Rd</sub> = <b>20</b>                     | 4.4 KIN         |
|  |   | DΛ   | V <sub>y,Ed</sub> / V <sub>pl,y,R</sub>            | shear resistance                                | avcaads das  | ian shoar for   |
|  |   | 1.4  | 55 - Desigin                                       | Shear resistance                                |  | ign shear ford  |
| Check design at end of span                          |   |  |  |   |  |                 |
| Check shear - Section 6.2.6                          |   |  |  |   |  |                 |
| Design shear force                                   | V <sub>y,Ed</sub> = <b>1.4</b> kN   |  | -  | ar resistance                                   | V <sub>pl,y,Rd</sub> = 20                            | <b>4.4</b> kN   |
|  |   |  | V <sub>y,Ed</sub> / V <sub>pl,y,R</sub>            |   |  |                 |
|  |   | PA   | SS - Design  | shear resistance                                | exceeds des  | ign shear ford  |
| Check bending moment - Sec                           | ction 6.2.5   |  |  |   |  |                 |
| Design bending moment                                | M <sub>y,Ed</sub> = <b>4.3</b> kNm  |  | -  | sistance moment                                 | M <sub>c,y,Rd</sub> = <b>58</b>                      | <b>.2</b> kNm   |
|  |   |  | $M_{y,Ed} / M_{c,y,F}$                             |   |  |                 |
|  | PASS - De   | sign bend  | ling resistan                                      | ce moment exce                                  | eds design be  | ending mome     |
| Check buckling resistance -                          | Section 6.3.2.1   |  |  |   |  |                 |
| Buckling resistance moment                           | M <sub>b,y,Rd</sub> = <b>58.2</b> kNm                                     |  | M <sub>y,Ed</sub> / M <sub>b,y,F</sub>             |   |  |                 |
|  | PASS - De   | sign buck  | ling resistan                                      | ce moment exce                                  | eds design be  | ending mome     |
| Check bending and axial force                        | e - Section 6.2.9   |  |  |   |  |                 |
| Maximum longitudinal stress                          |   | $\sigma_{y,Ed}$ = M <sub>y,</sub>                | <sub>Ed</sub> / W <sub>el.y</sub> + N <sub>E</sub> | <sub>Ed</sub> / A = <b>28</b> N/mm <sup>2</sup> |  |                 |
| Limiting longitudinal stress - Eq                    | J.6.42  | $\sigma_{y,lim}$ = f <sub>y</sub> /              | γ <sub>M0</sub> = <b>355</b> N/r                   | mm²   |  |                 |
|  |   | $\sigma_{y,\text{Ed}}$ / $\sigma_{y,\text{lin}}$ | n = <b>0.078</b>                                   |   |  |                 |
|  |   |  | -  | stress is less tha                              | n limiting lon                                       | gitudinal stres |
| Interaction formula - eq.6.2                         | $N_{Ed} / N_{c,Rd} + M_{y,Ed} /$  | -  |  |   |  |                 |
|  | P   | ASS - Utili                                      | sation of cor                                      | mbined bending                                  | and axial forc                                       | e is acceptab   |
| Interaction factors k <sub>ij</sub> for men          | -   |  | deformation  | ns - Table B.2                                  |  |                 |
| Interaction formulae                                 | max(0.054, 0.09) =  |  |  |   | <u>.</u> .   |                 |
|  |   | PASS - (   | combined be  | ending and comp                                 | pression chec  | ks are satisfie |
| Consider Combination 2 - 1.0                         | G + 1.0W (Service)  |  |  |   |  |                 |
| Check design 1730 mm along                           | a span  |  |  |   |  |                 |
|  |   |  |  |   |  |                 |
| Check y-y axis deflection - Se<br>Maximum deflection | ection 7.2.1<br>δ <sub>y</sub> = <b>0.9</b> mm                            |  | Allowable d  | eflection                                       | δ <sub>y,Allowable</sub> =                           | 10 mm           |
|  | oy – <b>U.9</b> IIIII   |  |  |   | Oy,Allowable =                                       |                 |
|  |   |  | δy / δy,Allowabl                                   | le = 0.093<br>Iowable deflectio                 | n avcada da  | sian doflootid  |
|  |   |  | FA33 - Al  |   | m exceeds de   | sign denectio   |
|  |   |  |  |   |  |                 |
| Column 2 design                                      |   |  |  |   |  |                 |
| Section details                                      | UC 152x152x23 (B  | S4-1)  |  |   |  |                 |
|  | UC 152x152x23 (B<br>S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | S4-1)  | Modulus of   | elasticity<br>.tensile strength                 | E = <b>210000</b><br>f <sub>u</sub> = <b>470</b> N/r |                 |

|  | Project  |              |              |      | Job Ref.       |      |  |
|--|----------|--------------|--------------|------|----------------|------|--|
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| Column 2 results summa   | ſ¥   | Unit        | Capacity  | Maximum   | Utilisation  | Result                                     |  |
|--|--|-------------|---|---|--|--|--|
| Shear resistance (y-y)   |  | kN          | 204.4   | 1.4   | 0.007  | PASS                                       |  |
| Bending resistance (y-y)   | ding resistance (y-y)  |             | 58.2  | 4.3   | 0.073  | PASS                                       |  |
| Compression resistance   |  | kN          | 524.3   | 5.7   | 0.011  | PASS                                       |  |
|  | _  |             |   |   |  |  |  |
| Comb. bending and axial  | force  |             |   |   | 0.090  | PASS                                       |  |
| Deflection (y-y)   |  | mm          | 10  | 0.9   | 0.093  | PASS                                       |  |
| Lateral restraint<br>Both flanges have lateral rest<br>Classification of cross sect  |  |             |   |   |  |  |  |
| Internal compression parts   | Class 1  |             | Outstan   | d flanges   | Class 3  |  |  |
|  |  |             |   |   | Sect   | ion is class                               |  |
| Check compression - Section  | on 6.2.4<br>N <sub>Ed</sub> = 5.7 kN   |             | Docian  | registered of contion   | N  | - 1020 2 41                                |  |
| Design compression force   | NEd - 3.7 KIN  |             | Design resistance of section $N_{c,Rd} = N_{pl,Rd} = 1038$<br>N <sub>Ed</sub> / N <sub>c,Rd</sub> = 0.005 |   |  |  |  |
|  |  | PAS         | SS - Design comp  | ression resistance  | exceeds design   | compressi                                  |  |
| Check y-y axis flexural bucl   | kling resistanc  | e - Sect    | ion 6.3.1.1   |   |  |  |  |
| Design buckling resistance   | N <sub>b,y,Rd</sub> = 868.   | <b>7</b> kN | N <sub>Ed</sub> / N <sub>b</sub>  | <sub>,y,Rd</sub> = <b>0.007</b>   |  |  |  |
|  |  |             | PASS - Design b   | uckling resistance  | exceeds design   | compressi                                  |  |
| Check z-z axis flexural buck   | ling resistanc   | e - Secti   | on 6.3.1.1  |   |  |  |  |
| Design buckling resistance   | N <sub>b,z,Rd</sub> = <b>524.</b>  | <b>3</b> kN |   | ,z,Rd <b>= 0.011</b>  |  | -  |  |
|  |  |             | _   | uckling resistance  | exceeas aesign (   | compressi                                  |  |
| Check torsional and torsion  |  | -           |   |   |  |  |  |
| Design buckling resistance   | N <sub>b,T,Rd</sub> = 671.   | 8 KIN       |   | <sub>,T,Rd</sub> = <b>0.008</b>   | ovcoods dosian   |  |  |
|  |  |             | FASS Design D   |   | exceeus uesigii i  | comprocei                                  |  |
|  |  |             |   | Ū   | -  | compressi                                  |  |
|  | an   |             |   | 5   | -  | compressi                                  |  |
| Check shear - Section 6.2.6  | _  |             |   | -   |  | -  |  |
| Check shear - Section 6.2.6  | <u>an</u><br>V <sub>y,Ed</sub> = <b>1.4</b> kM                                     | 1           | -   | shear resistance  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | -  |  |
| Check shear - Section 6.2.6  | _  | 1           | V <sub>y,Ed</sub> / V   | shear resistance  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | 4 kN                                       |  |
| Check shear - Section 6.2.6<br>Design shear force  | V <sub>y,Ed</sub> = <b>1.4</b> kM  | 1           | V <sub>y,Ed</sub> / V   | shear resistance  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | 4 kN                                       |  |
| Check shear - Section 6.2.6<br>Design shear force<br>Check design at end of spa  | V <sub>y,Ed</sub> = <b>1.4</b> kM  | 1           | V <sub>y,Ed</sub> / V   | shear resistance  | V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | 4 kN                                       |  |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6  | V <sub>y,Ed</sub> = <b>1.4</b> kM  |             | V <sub>y,Ed</sub> / V<br>PASS - Des   | shear resistance<br><sub>pl.y.Rd</sub> = 0.007<br>ign shear resistanc   | V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design   | 4 kN<br>n shear for                        |  |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6  | V <sub>y,Ed</sub> = <b>1.4</b> kM  |             | V <sub>y,Ed</sub> / V<br><b>PASS - Des</b> i<br>Design  | shear resistance<br><sub>pl.y.Rd</sub> = <b>0.007</b><br><i>ign shear resistanc</i><br>shear resistance                 | V <sub>pl,y,Rd</sub> = <b>204.</b> 4   | 4 kN<br>n shear for                        |  |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6  | V <sub>y,Ed</sub> = <b>1.4</b> kM  |             | V <sub>y,Ed</sub> / V<br><b>PASS - Des</b><br>Design<br>V <sub>y,Ed</sub> / V                             | shear resistance<br>pl.y.Rd = <b>0.007</b><br><b>ign shear resistance</b><br>shear resistance<br>pl.y.Rd = <b>0.007</b> | V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>V <sub>pl,y,Rd</sub> = 204.4                     | 4 kN<br>n shear for<br>4 kN                |  |
| Check design at start of spa<br>Check shear - Section 6.2.6<br>Design shear force<br>Check design at end of spa<br>Check shear - Section 6.2.6<br>Design shear force | V <sub>y,Ed</sub> = <b>1.4</b> kM<br><u>n</u><br>V <sub>y,Ed</sub> = <b>1.4</b> kM |             | V <sub>y,Ed</sub> / V<br><b>PASS - Des</b><br>Design<br>V <sub>y,Ed</sub> / V                             | shear resistance<br><sub>pl.y.Rd</sub> = <b>0.007</b><br><i>ign shear resistanc</i><br>shear resistance                 | V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>V <sub>pl,y,Rd</sub> = 204.4                     | 4 kN<br>n shear for<br>4 kN                |  |
| Check shear - Section 6.2.6<br>Design shear force<br><u>Check design at end of spa</u><br>Check shear - Section 6.2.6  | V <sub>y,Ed</sub> = <b>1.4</b> kM<br><u>n</u><br>V <sub>y,Ed</sub> = <b>1.4</b> kM | l           | V <sub>y,Ed</sub> / V<br>PASS - Desi<br>Design<br>V <sub>y,Ed</sub> / V<br>PASS - Desi                    | shear resistance<br>pl.y.Rd = <b>0.007</b><br><b>ign shear resistance</b><br>shear resistance<br>pl.y.Rd = <b>0.007</b> | V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design<br>V <sub>pl,y,Rd</sub> = 204.4<br>e exceeds design | 4 kN<br>n shear for<br>4 kN<br>n shear for |  |

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|  | PASS  | S - Des                    | ian bendi                                | ina resistance   | moment ex  | xceeds design be   | ndina mon   |
| Check buckling resistance -  |   |                            | 5  | J  |  | <b>J</b>   | J   |
| Buckling resistance moment   | M <sub>b,y,Rd</sub> = 58.2 k                          | Nm                         |  | M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>                              | = 0.073  |  |   |
|  |   |                            | ign buckl                                |  |  | xceeds design be   | nding mon   |
| Check bending and axial for  | ce - Section 6.2                                      | .9                         |  |  |  |  |   |
| Maximum longitudinal stress  |   |                            | $\sigma_{y,Ed} = M_{y,E}$                | d / W <sub>el.y</sub> + N <sub>Ed</sub>                              | / A = <b>28</b> N/m                                | im²  |   |
| Limiting longitudinal stress - Ec  | q.6.42  | c                          | $\sigma_{y,lim} = f_y / \gamma_{y,lim}$  | <sub>имо</sub> = <b>355</b> N/mr                                     | n²   |  |   |
|  |   | c                          | $\sigma_{ m y,Ed}  /  \sigma_{ m y,lim}$ | = 0.078  |  |  |   |
|  |   |                            |  | -  | ess is less  | than limiting long   | itudinal stı  |
| Interaction formula - eq.6.2   | N <sub>Ed</sub> / N <sub>c,Rd</sub> + M               |                            |  |  |  |  |   |
|  |   |                            |  |  |  | ng and axial force   | e is accepta  |
| Interaction factors k <sub>ij</sub> for mer  | -   |                            |  | deformations   | - Table B.2  |  |   |
| Interaction formulae   | max(0.054, 0.0  | ,                          |  |  |  |  |   |
|  |   |                            | PASS - C                                 | ombinea ben  | aing and co  | ompression check   | is are satis  |
| Consider Combination 2 - 1.0   | )G + 1.0W (Serv                                       | <u>vice)</u>               |  |  |  |  |   |
| Check design 1730 mm along   | <u>g span</u>   |                            |  |  |  |  |   |
| Check y-y axis deflection - So   | ection 7.2.1  |                            |  |  |  |  |   |
| Maximum deflection   | δ <sub>v</sub> = <b>0.9</b> mm                        |                            |  | Allowable def  | lection  | $\delta_{\rm V,Allowable} = 1$                                   | l <b>0</b> mm   |
|  | - ,   |                            |  | $δ_y$ / $δ_{y,Allowable}$ :  |  | - ),   |   |
|  |   |                            |  |  |  |  |   |
|  |   |                            |  |  |  | ction exceeds des  | sign deflec   |
| Beam 1 design  |   |                            |  |  |  | ction exceeds des  | sign deflec   |
| <u>Beam 1 design</u><br>Section details  | UB 254x146x3  | 1 (BS                      | 4-1)                                     |  |  | ction exceeds des  | sign deflec   |
| Section details  | UB 254x146x3<br>S355                                  | 1 (BS4                     | 4-1)                                     |  | wable defle  | ction exceeds des<br>E = 210000                                  | -   |
| Section details<br>Steel grade   |   | -                          | 4-1)                                     | PASS - Allo  | wable defle<br>asticity                            | E = 210000   | N/mm²   |
| Section details<br>Steel grade   | S355  | -                          | 4-1)                                     | PASS - Allo<br>Modulus of el   | wable defle<br>asticity                            | E = 210000   | N/mm²   |
| Section details<br>Steel grade   | S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | -                          | 4-1)<br>Capacit                          | PASS - Allo<br>Modulus of el<br>Nominal ult.te                       | wable defle<br>asticity                            | E = 210000   | N/mm²   |
| Section details<br>Steel grade<br>Nominal yield strength   | S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | 2                          |  | PASS - Allo<br>Modulus of el<br>Nominal ult.te                       | wable defle<br>asticity<br>nsile strengt           | E = <b>210000</b><br>th f <sub>u</sub> = <b>470</b> N/m          | N/mm <sup>2</sup><br>1m <sup>2</sup>                          |
| Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary   | S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | 2<br>Jnit                  | Capacit                                  | PASS - Allo<br>Modulus of el<br>Nominal ult.te                       | wable defle<br>asticity<br>msile strengt<br>aximum | E = 210000<br>th f <sub>u</sub> = 470 N/m                        | N/mm <sup>2</sup><br>1m <sup>2</sup>                          |
| Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary<br>Shear resistance (y-y)                             | S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | <sup>2</sup><br>Jnit<br>(N | Capacit<br>335.5                         | PASS - Allo<br>Modulus of el<br>Nominal ult.te<br>y Ma               | wable defle<br>asticity<br>nsile strengt<br>aximum | E = <b>210000</b><br>fu = <b>470</b> N/m<br>Utilisation<br>0.014 | N/mm <sup>2</sup><br>1m <sup>2</sup><br>Resul                 |
| Section details<br>Steel grade<br>Nominal yield strength<br>Beam 1 results summary<br>Shear resistance (y-y)<br>Bending resistance (y-y) | S355<br>fy = <b>355</b> N/mm<br>k                     | 2<br>Jnit<br>(N            | <b>Capacit</b><br>335.5<br>42.2          | PASS - Allo<br>Modulus of el<br>Nominal ult.te<br>y Ma<br>4.8<br>8.2 | wable defle<br>asticity<br>nsile strengt<br>aximum | E = 210000 fu = 470 N/m Utilisation 0.014 0.196                  | N/mm <sup>2</sup><br>1m <sup>2</sup><br>Resul<br>PASS<br>PASS |
| Steel grade<br>Nominal yield strength<br>Beam 1 results summary<br>Shear resistance (y-y)<br>Bending resistance (y-y)                    | S355<br>f <sub>y</sub> = <b>355</b> N/mm <sup>2</sup> | 2<br>Jnit<br>(N            | <b>Capacit</b><br>335.5<br>42.2          | PASS - Allo<br>Modulus of el<br>Nominal ult.te<br>y Ma<br>4.8<br>8.2 | wable defle<br>asticity<br>nsile strengt<br>aximum | E = 210000 fu = 470 N/m Utilisation 0.014 0.196                  | N/mm<br>1m <sup>2</sup>                                       |

#### Check compression - Section 6.2.4

Design compression force  $N_{Ed}$  = 1.4 kN

Design resistance of section

 $N_{c,Rd}$  =  $N_{pl,Rd}$  = **1038.2** kN

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|   |   |   | N <sub>Ed</sub> / N <sub>c,Rd</sub> = 0  | .001  |   |                            |  |
|   |   | PASS - Desig  | gn compressio  | on resistance e   | exceeds desig   | n compress                 |  |
| Check y-y axis flexural buckli  | ng resistance -   | Section 6.3.1.  | 1  |   |   |                            |  |
| Design buckling resistance  | N <sub>b,y,Rd</sub> = 908 kN  |   | $N_{Ed} / N_{b,y,Rd} =$  | 0.002   |   |                            |  |
|   |   | PASS -  | Design bucklir   | ng resistance e   | xceeds desig  | n compress                 |  |
| Check z-z axis flexural buckli  | ng resistance -   | Section 6.3.1.  | 1  |   |   |                            |  |
| Design buckling resistance  | N <sub>b,z,Rd</sub> = <b>121.5</b>  | Ň   | $N_{Ed} / N_{b,z,Rd} =$  | 0.012   |   |                            |  |
|   |   | PASS -  | Design bucklir   | ng resistance e   | xceeds desig  | n compress                 |  |
| Check torsional and torsional   | l-flexural buckli   | ng resistance   | - Section 6.3.1  | .1  |   |                            |  |
| Design buckling resistance  | N <sub>b,T,Rd</sub> = 541.7   | ٢N  | $N_{Ed} / N_{b,T,Rd} =$  | 0.003   |   |                            |  |
|   |   | PASS -  | Design bucklir   | ng resistance e   | xceeds desig  | n compress                 |  |
| Check design at start of span   |   |   |  |   |   |                            |  |
| Check shear - Section 6.2.6   | •   |   |  |   |   |                            |  |
| Design shear force  | V <sub>v.Ed</sub> = <b>4.8</b> kN   |   | Design shear   | resistance  |   |                            |  |
| Design shear lorde  | V y,Ed - 4.0 KIV  |   | V <sub>y,Ed</sub> / V <sub>c,y,Rd</sub> =  |   | V <sub>c,y,Rd</sub> = V <sub>pl,y,Rd</sub> = <b>204.4</b> k |                            |  |
|   |   | PA  |  | ear resistance  | exceeds des   | ian shear fo               |  |
| Check bending moment - Sec  | tion 6 2 5  |   | <b>j</b> -   |   |   | <b>J</b>                   |  |
| Design bending moment   | M <sub>y,Ed</sub> = <b>4.3</b> kNm  | 1   | Rending resis  | tance moment  | M <sub>c,y,Rd</sub> = 13                                    | 9 5 kNm                    |  |
| Design benang memeri  |   |   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>  |   | Wic,y,Ru  |                            |  |
|   | PASS  | - Design bend   |  | moment exce   | eds design b  | ending mom                 |  |
| Check buckling resistance - S   | Section 6.3.2.1   |   |  |   |   |                            |  |
| Buckling resistance moment  | M <sub>b,y,Rd</sub> = <b>42.2</b> kl  | ٧m  | M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>  | = 0.101   |   |                            |  |
| Ū   |   |   |  | moment exce   | eds design b  | ending mom                 |  |
| Check bending and axial forc  | e - Section 6.2.  | 9   |  |   |   |                            |  |
| Bending and axial force check   |   |   | $N_{Ed} / N_{v,lim} = 0$   | .01   |   |                            |  |
| Allowance need not be ma  |   |   |  |   | e moment ab   | out the y-y a              |  |
| Interaction factors kij for men   |   |   | -  |   |   |                            |  |
| Interaction formulae  | max(0.095, 0.1  |   | derermatione   |   |   |                            |  |
|   |   | -   | Combined ben   | ding and comp   | pression chec   | ks are satisf              |  |
|   |   |   |  | -   |   |                            |  |
| Check design 4150 mm along  | enan  |   |  |   |   |                            |  |
| Check design 4150 mm along  |   |   |  |   |   |                            |  |
| Check bending moment - Sec  | tion 6.2.5  |   | Den dia a secie  |   | M - 42  |                            |  |
|   |   | I   | -  | tance moment  | M <sub>c,y,Rd</sub> = <b>13</b>                             | 9.5 kNm                    |  |
| Check bending moment - Sec  | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm   |   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>  | = 0.059   |   |                            |  |
| Check bending moment - Sec<br>Design bending moment   | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i>  |   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>  |   |   |                            |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S  | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1   | - Design bend   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub>  | = 0.059<br>moment exce  |   |                            |  |
| Check bending moment - Sec<br>Design bending moment   | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kl                | <b>- Design bend</b><br>Nm  | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub>                                    | = 0.059<br><i>moment exce</i><br>= 0.196                            | eds design b  | ending mom                 |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment  | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br>PASS<br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kI<br>PASS               | - Design bend<br>Nm<br>- Design buckl                                   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance                 | = 0.059<br>moment exce<br>= 0.196<br>moment exce                    | eds design b  | ending mom                 |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Interaction factors k <sub>ij</sub> for mem                         | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kl<br><i>PASS</i> | - Design bend<br>Nm<br>- Design buckl                                   | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance                 | = 0.059<br>moment exce<br>= 0.196<br>moment exce                    | eds design b  | ending mom                 |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment  | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br>PASS<br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kI<br>PASS               | - Design bend<br>Nm<br>- Design buckl<br>le to torsional<br>07) = 0.207 | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance<br>deformations | = 0.059<br>= moment exce<br>= 0.196<br>= moment exce<br>- Table B.2 | eds design b<br>eds design b                                | ending mom<br>ending mom   |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Interaction factors k <sub>ij</sub> for mem                         | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kl<br><i>PASS</i> | - Design bend<br>Nm<br>- Design buckl<br>le to torsional<br>07) = 0.207 | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance<br>deformations | = 0.059<br>moment exce<br>= 0.196<br>moment exce                    | eds design b<br>eds design b                                | ending mome<br>ending mome |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Interaction factors k <sub>ij</sub> for mem                         | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kl<br><i>PASS</i> | - Design bend<br>Nm<br>- Design buckl<br>le to torsional<br>07) = 0.207 | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance<br>deformations | = 0.059<br>= moment exce<br>= 0.196<br>= moment exce<br>- Table B.2 | eds design b<br>eds design b                                | ending mom<br>ending mom   |  |
| Check bending moment - Sec<br>Design bending moment<br>Check buckling resistance - S<br>Buckling resistance moment<br>Interaction factors k <sub>ij</sub> for mem<br>Interaction formulae | tion 6.2.5<br>M <sub>y,Ed</sub> = 8.2 kNm<br><i>PASS</i><br>Section 6.3.2.1<br>M <sub>b,y,Rd</sub> = 42.2 kl<br><i>PASS</i> | - Design bend<br>Nm<br>- Design buckl<br>le to torsional<br>07) = 0.207 | M <sub>y,Ed</sub> / M <sub>c,y,Rd</sub><br>ling resistance<br>M <sub>y,Ed</sub> / M <sub>b,y,Rd</sub><br>ling resistance<br>deformations | = 0.059<br>= moment exce<br>= 0.196<br>= moment exce<br>- Table B.2 | eds design b<br>eds design b                                | ending mome<br>ending mome |  |

|   | Project  |                    |   |                | Job Ref.  |               |
|---|--|--------------------|---|----------------|---|---------------|
| BAYLISS   | ,  | Willington         | Sport Pavillion                           |                | -   | 000           |
| CONSULTING  | Section  |                    |   |                | Sheet no./rev.                                  |               |
| il and Structural Engineering Consultants                         |  | Structura          | I Calculations                            |                |   | 51            |
| 01332 292192  | Calc. by   | Date               | Chk'd by                                  | Date           | App'd   | Date          |
|   | TGB  | 01.06.23           |   |                |   |               |
|   |  | •                  | $V_{v,Ed} / V_{c,v,Rd} =$                 | 0.024          |   |               |
|   |  |                    | 37 37                                     |                |   |               |
|   |  | PA                 | SS - Design she                           | ear resistance | exceeds desig                                   | n shear for   |
| Check bending moment - Se   | ction 6.2.5  |                    |   |                |   |               |
| Design bending moment   | M <sub>y,Ed</sub> = <b>4.3</b> kNm                 | I                  | Bending resista                           | ance moment    | M <sub>c,y,Rd</sub> = <b>139.</b>               | 5 kNm         |
|   |  |                    | $M_{y,Ed} / M_{c,y,Rd} =$                 | 0.03           |   |               |
|   | PASS   | - Design bend      | ding resistance                           | moment excee   | eds design ben                                  | ding mome     |
| Check buckling resistance -                                       | Section 6.3.2.1                                    |                    |   |                |   |               |
| Buckling resistance moment  | M <sub>b.v.Rd</sub> = <b>42.2</b> kM               | ٧m                 | M <sub>v.Ed</sub> / M <sub>b.v.Rd</sub> = | 0.101          |   |               |
| 5   |  |                    | ling resistance                           |                | eds design ben                                  | ding mome     |
| Interaction factors kij for me                                    | mbers susceptib                                    | le to torsiona     | I deformations -                          | Table B.2      |   |               |
| Interaction formulae  | max(0.095, 0.1                                     | 12) = <b>0 112</b> |   |                |   |               |
|   | max(0.035, 0.1                                     | 12) - <b>U.IIZ</b> |   |                |   |               |
|   | max(0.035, 0.1                                     | ,                  | Combined bend                             | ing and comp   | ression checks                                  | s are satisfi |
| Consider Combination 2 - 1.                                       |  | PASS -             | Combined bend                             | ing and comp   | ression checks                                  | s are satisfi |
| <u>Consider Combination 2 - 1.</u><br>Check design 4150 mm alon   | <u>0G + 1.0W (Servi</u>                            | PASS -             | Combined bend                             | ing and comp   | ression checks                                  | s are satisfi |
|   | 0G + 1.0W (Servi<br>g span                         | PASS -             | Combined bend                             | ing and comp   | ression checks                                  | s are satisfi |
| Check design 4150 mm alon   | 0G + 1.0W (Servi<br>g span                         | PASS -             | Combined bend                             |                | ression checks<br>δ <sub>y,Allowable</sub> = 23 |               |
| <u>Check design 4150 mm alon</u><br>Check y-y axis deflection - S | <u>0G + 1.0W (Servi</u><br>g span<br>Section 7.2.1 | PASS -             |   | ection         |   |               |

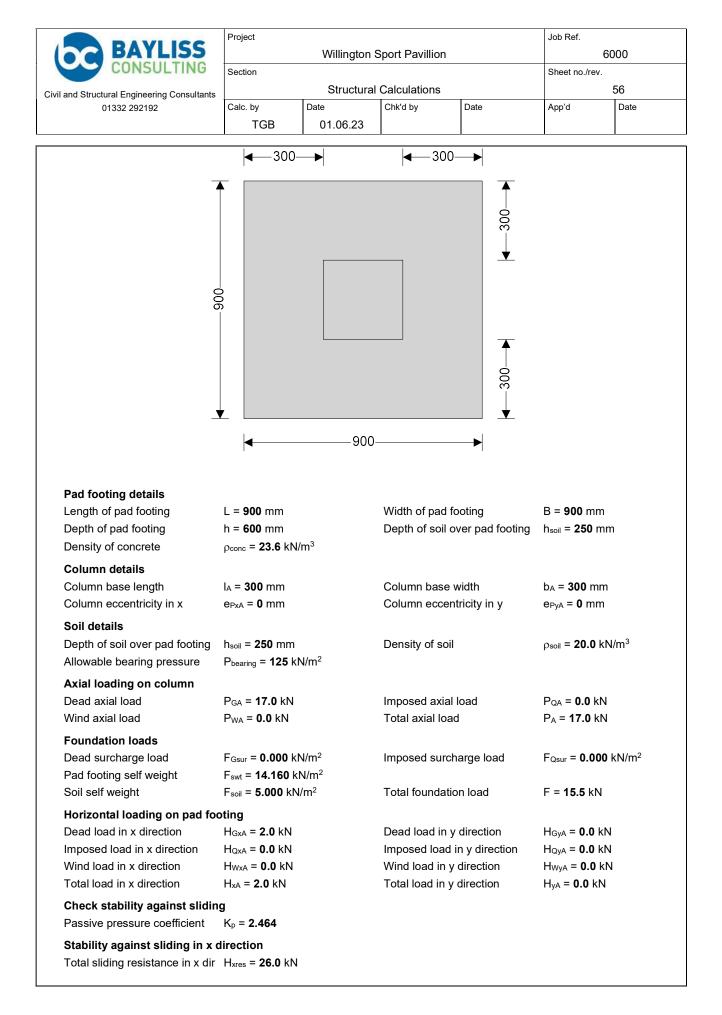
# USE 152 X 152 X 23KG UC S355 POSTS AND 254 X 146 X 31KGUB S355 FOR B02

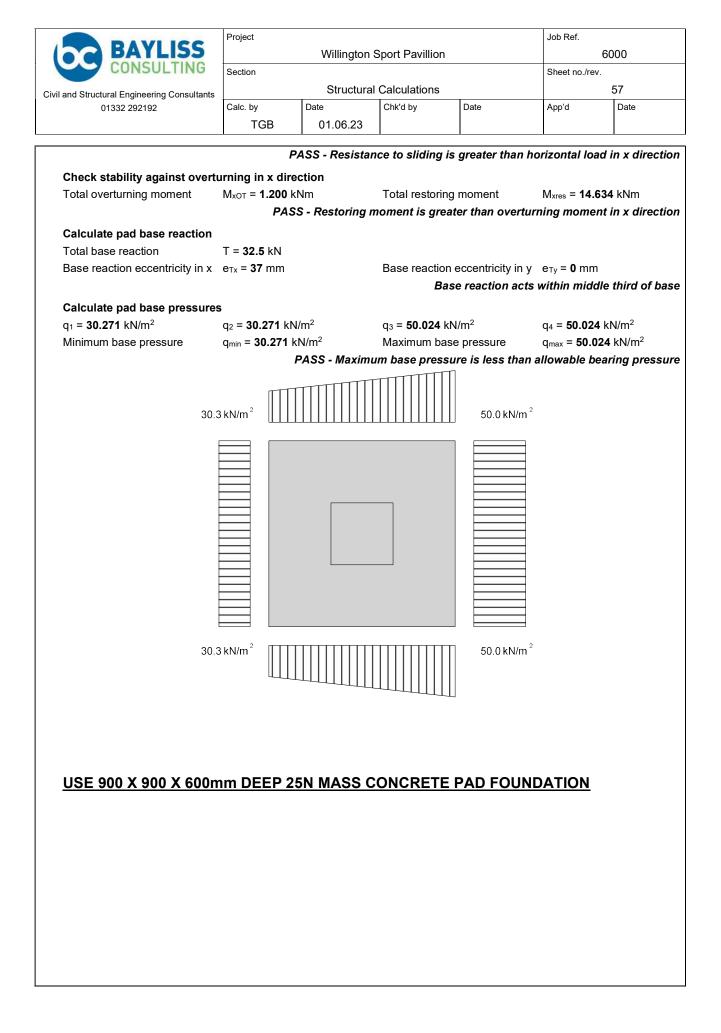
|  | Project     |            |              |      | Job Ref.     |      |
|--|-------------|------------|--------------|------|--------------|------|
| BAYLISS                                      |             | Willington |              | 6000 |              |      |
| CONSULTING                                   | Section     |            |              |      | Sheet no./re | ev.  |
| Civil and Structural Engineering Consultants |             | Structural | Calculations |      |              | 52   |
| 01332 292192                                 | Calc. by    | Date       | Chk'd by     | Date | App'd        | Date |
|  | TGB         | 01.06.23   |              |      |              |      |
|  |             |            |              |      |              |      |
| CONNECTION OF B02 TO PO                      | <u>ST</u>   |            |              |      |              |      |
|  |             |            |              |      |              |      |
| Connection Forces (ultimate)                 |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| L. Dead + Live                               |             |            |              |      |              |      |
| VI = - 5.7 kNm                               |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| S = 6.5 kN                                   |             |            |              |      |              |      |
| *  |             |            |              |      |              |      |
| A = 1.9 kN Compression                       |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| <ol><li>Dead + Live + Side Wind</li></ol>    | 1 * Governs |            |              |      |              |      |
| VI = - 8.1 kNm                               |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| 5 = 7.1 kN                                   |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| A = 2.7 kN Comprossion                       |             |            |              |      |              |      |
| A = 2.7 kN Compression                       |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| 3. Dead + Gable Wind                         |             |            |              |      |              |      |
| VI = -4.3 kNm                                |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
| 5 = 4.8 kN                                   |             |            |              |      |              |      |
| *  |             |            |              |      |              |      |
| A = 1.4 kN Compression                       |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
|  |             |            |              |      |              |      |
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|--|--|
| CONSULTING Section   | Sheet no./rev.   |
| Structural Calculations  | 53   |
| Other Structural Engineering Consultants     Output Structural Calculations       01332 292192     Calc. by     Date     Chk'd by     Date   | App'd Date   |
| TGB 01.06.23   |  |
| eam-Column Moment Connection 1   |  |
| 0.025m   | 70.0   |
| 0.000m   | 20   |
|  |  |
|  |  |
| 8.0  |  |
|  |  |
| $\wedge$   | V  |
|  |  |
| UB 254x146x31 S355 (Slope 0.0000°)   |  |
| Design Code: BS 5950-1 : 2000<br>Design Summary  |  |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti   | lisation State   |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A  | 0.333 Pa<br>0.024 Pa   |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa  |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A<br>Weld 1 A   | 0.333 Pa<br>0.024 Pa<br>Not Check  |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A<br>Weld 1 A<br>Basic Details  | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa  |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A<br>Beam<br>Stiffener 1 A<br>Basic Details<br>Face A<br>D. Combination Name Moment Shear Force Ax<br>[kNm] (kN] (kN)   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]                   |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam Stiffener 1 A<br>Beam Stiffener 1 A<br>Basic Details<br>Face A<br>Dead + Live + Side Wind -8.1 7.1 2.7   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]                   |
| Design Code: BS 5950-1 : 2000         Design Summary       Tace       Uti         Item       Combination       Face       Uti         Moment       1       A         Shear       1       A         Beam       1       A         Stiffener       1       A         Weld       1       A         Basic Details       -       -         Face A         O.       Combination Name       Moment<br>[kNm]       Shear Force<br>[kN]       Ax         Dead + Live + Side Wind       -8.1       7.1       2.7  | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]                   |
| Design Code: BS 5950-1 : 2000         Titem Combination Face Uti         Moment       1       A         Shear       1       A         Beam       1       A         Beam       1       A         Stiffener       1       A         Weld       1       A         Basic Details       Stiffener       1       A         Beam       Stiffener       1       A         Beam       1       A       A         Beam       Basic Details       Eace A       A         Beasic Details       Eace A       Eace A       Eace A       Eace A         O.       Combination Name       Moment<br>[kNm]       Shear Force<br>[kN]       Ax         Dead + Live + Side Wind       -8.1       7.1       2.7         Face A         Item       Value       Units         S.O.P. Level       0.0       m   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0            |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam Stiffener 1 A<br>Weld 1 A<br>Basic Details<br>Face A<br>Dead + Live + Side Wind -8.1 7.1 2.7<br>Face A<br>Item Value Units<br>S.O.P. Level 0.0 m<br>Beam angle, $\theta_b$ 0.0 °   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0            |
| Design Code: BS 5950-1 : 2000         Design Summary         Item       Combination       Face       Utile         Moment       1       A       A         Shear       1       A       Beam       Beam <td>0.333 Pa<br/>0.024 Pa<br/>Not Check<br/>0.093 Pa<br/>0.750 Pa<br/>ial Load Moment<br/>(Sharp End)<br/>[kNm]<br/>0.0</td>  | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0            |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A<br>Weld 1 A<br>Basic Details<br>Face A<br>o. Combination Name Moment [kNm] Shear Force [kN] [kl<br>Dead + Live + Side Wind -8.1 7.1 2.7<br>Face A<br>Item Value Units<br>S.O.P. Level 0.0 m<br>Beam angle, $\theta_b$ 0.0 °<br>Overall joint depth 251.4 mm   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0            |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam Stiffener 1 A<br>Weld 1 A<br>Basic Details<br>Face A<br>o. Combination Name Moment [kNm] Shear Force Ax<br>[kN] [kl]<br>Dead + Live + Side Wind -8.1 7.1 2.7<br>Face A<br>Item Value Units<br>S.O.P. Level 0.0 m<br>Beam angle, θ <sub>b</sub> 0.0 °<br>Overall joint depth 251.4 mm<br>Section geometry<br>Design Combination: Dead + Live + Side Wind<br>Moment Capacity<br>Face A, critical<br>Item Value Units   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>ial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0            |
| Design Code: BS 5950-1 : 2000<br>Design SummaryItem Combination IFace UtiMoment1AShear1ABeam1AStiffener1AWeld1ABasic Details<br>Face AShear ForceAxCombination NameMoment<br>[kNm]Shear Force<br>[kNm]AxDead + Live + Side Wind-8.17.12.7Face AItem Value UnitsS.O.P. Level0.0Beam angle, $\theta_b$ 0.0 $0.0$ Overall joint depth251.4mmSection geometryDesign Combination: Dead + Live + Side Wind<br>Moment Capacity<br>Face A, criticalValue UnitsItemValue stateUnitsItemValue stateUnitsTension bolt resistance, $\Sigma P_r + N$ 148.5kN  | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>cial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0<br>Remarl |
| Design Code: BS 5950-1 : 2000         Design Summary         Item       Combination       Face       Uti         Moment       1       A       A         Shear       1       A       Beam       A         Beam       1       A       Beam       A         Stiffener       1       A       A         Weld       1       A       Basic Details       Face A         Design Combination Name       Moment [kNm]       Shear Force [kN]       Ax         Dead + Live + Side Wind       -8.1       7.1       2.7         Face A       1       7.1       2.7         Face A       0.0       m       Beam angle, $\theta_b$ 0.0       m         So.P. Level       0.0       m       Beam angle, $\theta_b$ 0.0       °         Sction geometry       251.4       mm       Section geometry       Design Combination: Dead + Live + Side Wind       Moment Capacity         Face A, critical       Item       Value       Units       Itemsion bolt resistance, $\Sigma P_r + N$ 148.5       kN   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>cial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0<br>Remarl |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam<br>Stiffener 1 A<br>Basic Details<br>Face A<br>o. Combination Name Moment [kNm] [kN] (kN] [k1]<br>Dead + Live + Side Wind -8.1 7.1 2.7<br>Face A<br>Item Value Units<br>S.O.P. Level 0.0 m<br>Beam angle, $\theta_b$ 0.0 °<br>Overall joint depth 251.4 mm<br>Section geometry<br>Design Combination: Dead + Live + Side Wind<br>Moment Capacity<br>Face A, critical<br>Item Value Units<br>Tension bolt resistance, $\Sigma P_r$ + N 148.5 kN<br>Column web resistance, $P_c$ 133.5 kN<br>Beam flange bearing, $P_c$ 624.5 kN   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>cial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0<br>Remarl |
| Design Code: BS 5950-1 : 2000Design SummaryItemCombinationFaceUtiMoment1AShear1ABeam1ABasic Details1ABasic DetailsAFace A1ADead + Live + Side Wind-8.17.12.7Face AItemValueUnitsSO.P. Level0.0mBeam angle, $\theta_b$ 0.0mSection geometryDesign Combination: Dead + Live + Side Wind251.4mmSection geometryDesign Combination: Dead + Live + Side WindMoment CapacityFace AItemValueUnitsTension bolt resistance, $\Sigma P_r + N$ 148.5kNColumn web resistance, $\Sigma P_r + N$ 148.5kNColumn web resistance, $P_c$ 133.5kNBeam flange bearing, $P_c$ 624.5kNCompression force, $F_c$ 133.5kN   | 0.333 Pa<br>0.024 Pa<br>Not Check<br>0.093 Pa<br>0.750 Pa<br>cial Load Moment<br>(Sharp End)<br>[kNm]<br>0.0<br>Remarl |
| Design Code: BS 5950-1 : 2000<br>Design Summary<br>Item Combination Face Uti<br>Moment 1 A<br>Shear 1 A<br>Beam 1 A<br>Beam 3<br>Stiffener 1 A<br>Basic Details<br>Face A<br>Dead + Live + Side Wind -8.1 7.1 2.7<br>Face A<br>Item Value Units<br>S.O.P. Level 0.0 m<br>Beam angle, $\theta_b$ 0.0 °<br>Dverall joint depth 251.4 mm<br>Section geometry<br>Design Combination: Dead + Live + Side Wind<br>Amment Capacity<br>Face A, critical<br>Item Value Units<br>Ethem Units<br>Source A, critical<br>Item Value Units<br>Source A, critical<br>Item Value Units<br>Section geometry<br>Design Combination: Dead + Live + Side Wind<br>Amment Capacity<br>Face A, critical<br>Item Value Units<br>Source A, critical<br>Item Value Units<br>Source A, critical<br>Item Value Combination: Dead + Live + Side Wind<br>Amment Capacity<br>Face A, critical<br>Item Value Value Vinits<br>Source Capacity<br>Face A, critical<br>Item Source Suppose Su | 0.333<br>0.024<br>Not Cha<br>0.093<br>0.750<br>(Sharp End)<br>[kNm]<br>0.0<br>Rema                                     |

| BAYLISS<br>CONSULTING   | Project         | Willington S                   | Sport Pavillion          |                         | Job Ref.<br>60<br>Sheet no./rev. | 000                  |
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| ivil and Structural Engineering Consultants<br>01332 292192   | Calc. by<br>TGB | Structural<br>Date<br>01.06.23 | Calculations<br>Chk'd by | Date                    |                                  | 54<br>Date           |
| Item  |                 |                                | alue Units               |                         |                                  | Remarks              |
| Utilisation ratio<br>Pass<br><b>Shear Capacity</b>  |                 | (                              | ).333                    |                         |                                  |                      |
| Face A, critical<br>Item  |                 | Value                          | Unito                    |                         |                                  | Remarks              |
| Bearing strength, p <sub>b</sub><br>Shear capacity, V <sub>c</sub><br>Shear force, V<br>Utilisation ratio |                 |                                | N/mm²<br>kN              |                         |                                  | Remarks              |
| Pass<br>Beam Web Capacity   |                 |                                |                          |                         |                                  |                      |
| Face A, critical<br>Item  |                 |                                | Utilisatio               | n                       |                                  | Status               |
| Beam web<br>Not applicable<br>Stiffener Checks<br>Face A, critical  |                 |                                |                          | -                       |                                  | Not applicable       |
| Item  |                 |                                | Utilisa                  | tion                    |                                  | Status               |
| Beam flange (top)<br>Beam flange (bottom)<br>Weld Checks  |                 |                                |                          | 0.093                   |                                  | Not Checkeo<br>Pass  |
| Face A, critical<br>Item  |                 |                                |                          | Utilisation             |                                  | Status               |
| Tension flange weld (beam btm. flang  |                 |                                |                          | 0.324                   |                                  | Pass                 |
| Compression flange weld (beam top f<br>Tension web weld<br>Shear web weld                                 | lange)          |                                |                          | 0.750<br>0.692<br>0.040 |                                  | Pass                 |
|   |                 |                                |                          |                         |                                  | Pass<br>Pass<br>Pass |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pass                 |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |
| Tension web weld<br>Shear web weld  |                 |                                |                          | 0.692                   |                                  | Pas                  |

| BAYLISS                                      | Project          | Willington    | Sport Pavillion         |              |          | Job Ref.   | 6000                    |
|--|------------------|---------------|-------------------------|--------------|----------|------------|-------------------------|
| CONSULTING                                   | Section          |               |                         | Sheet no./re |          |            |                         |
| Civil and Structural Engineering Consultants | - · ·            | 1             | Structural Calculations |              |          |            | 55                      |
| 01332 292192                                 | Calc. by<br>TGB  | Date 01.06.23 | Chk'd by                | by Date      |          | App'd      | Date                    |
| FOUNDATION LOADS                             |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
| Load Combination                             |                  |               |                         |              |          |            |                         |
|  |                  |               |                         | Δ            | 1        |            |                         |
| a. Dead + Live                               | V =              | 15.4 kN 🕁     |                         |              | 5.4 kN   |            |                         |
|  | H =              | 1.4 kN ◀─     |                         |              | 1.4 kN - | →          |                         |
|  | M =              | 0 kNm         | N                       | 1 = 0        | kNm      |            |                         |
| b. Dead + Live + Side Wind                   | V =              | 14.6 kN 🗸     | V                       | = 1          | 6.9 kN   | ,          |                         |
| * Governs                                    | H =              | 0.9 kN 🗲      | н                       |              | 1.9 kN - |            |                         |
|  | M =              | 0 kNm         | Ν                       | 1 = 0        | kNm      |            |                         |
| c. Dead + Gable Wind                         | V =              | 7.5 kN 🖌      | v                       | = 7          | .5 kN    |            |                         |
|  | H =              | 1.4 kN 🗲      | Н                       | = -          | 1.4 kN-  | <b>→</b>   |                         |
|  | M =              | 0 kNm         | Ν                       | 1 = 0        | kNm      |            |                         |
|  |                  |               |                         |              |          |            |                         |
| FOUNDATION TO 152                            | <u>X 23KG UC</u> | <u>POSTS</u>  |                         |              |          |            |                         |
| PAD FOOTING ANALYSIS                         | & DESIGN         | N (BS8110)    |                         |              |          |            |                         |
| PAD FOOTING ANALYSIS AN                      | D DESIGN (BS     | 8110-1:1997)  |                         |              |          |            |                         |
|  |                  |               |                         |              |          | Tedds calo | culation version 2.0.07 |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |
|  |                  |               |                         |              |          |            |                         |





|  | Project                 |          |                  |              |      |                   | Job Ref.     |      |
|--|-------------------------|----------|------------------|--------------|------|-------------------|--------------|------|
| BAYLISS                                      |                         | Wil      | lington S        | port Pavilli | on   |                   |              | 6000 |
| CONSULTING                                   | Section                 |          |                  |              |      |                   | Sheet no./re | ev.  |
| Civil and Structural Engineering Consultants | Structural Calculations |          |                  |              |      |                   |              | 58   |
| 01332 292192                                 | Calc. by                | Date     |                  | Chk'd by     | Date | е                 | App'd        | Date |
|  | TGB                     | 01.0     | 06.23            |              |      |                   |              |      |
| CHECK FACTOR OF SAFETY AG                    |                         | т        |                  |              |      |                   |              |      |
|  |                         | <u>.</u> |                  |              |      |                   |              |      |
| Dead load from roof and frame =              | 9.2                     | +        | 1.9              |              |      | = 11.1 kN         | 1↓           |      |
|  |                         |          |                  |              |      |                   | ·            |      |
| Swt Concrete Base =                          | 24                      | х        | 0.9 <sup>2</sup> | x            | 0.6  | = 11.6 kN         | ı↓           |      |
|  |                         |          |                  |              |      |                   |              |      |
| Overburden =                                 | 19                      | х        | 0.9 <sup>2</sup> | x            | 0.20 | <u>= 3.1 kN</u>   | <u>⊥</u> ↓   |      |
|  |                         |          |                  |              |      | = 25.8 kN         |              |      |
|  |                         |          |                  |              |      |                   | •            |      |
| Uplift from Wind =                           | 7.76/                   | 2        |                  |              |      | = 3.88 kN         | <b>↓</b>     |      |
|  |                         |          |                  |              |      |                   | I            |      |
| ∴ F. O . S =                                 | 25.8/                   | 3.88     |                  |              |      | <u>= 6.65 O</u> ł | <            |      |

## ∴ UPLIFT DOES NOT OCCUR

