Beam: Bm 1  
Span: 2.5 m.  

<table>
<thead>
<tr>
<th>Load name</th>
<th>Loading w1</th>
<th>Start x1</th>
<th>Loading w2</th>
<th>End x2</th>
<th>R1comp</th>
<th>R2comp</th>
<th>Defl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>U T o.w.</td>
<td>0.15</td>
<td>0</td>
<td>L</td>
<td>0.19</td>
<td>0.19</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>U T Wall</td>
<td>3.33x0.6</td>
<td>0</td>
<td>L</td>
<td>2.50</td>
<td>2.50</td>
<td>1.02</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Total load (unfactored): 5.37 kN  

Load types: U: UDL; Load positions are measured in m. from R1; Load durations: D: Dead; L: Live

Maximum B.M. = 1.68 kNm (unfactored (all loads applied)) at 1.25 m. from R1  
Maximum S.F. = 2.68 kN (unfactored) at R1  
Total mid-span deflection: 1.09 x 10^8 / EI (E in N/mm^2, I in cm^4)  

Steel beam calculation to BS449 Part 2 using S355 steel

SECTION SIZE: 127 x 76 x 13 UB  
S355

D=127.0 mm  B=76.0 mm  t=4.0 mm  T=7.6 mm  I_x=473 cm^4  r_y=1.84 cm  Z_y=75.0 cm^3

Bending

L_e/r_y = 2.50 x 100/1.84 = 136  
D/T = 16.7

Permissible bending stress, p_bc = 143 N/mm^2 (Table 3b)

Actual bending stress, f_bc = 1.68 x 1000/75.0 = 22.4 N/mm² OK

Shear

Permissible shear stress, p_s = 140 N/mm² [Table 11]

Maximum shear in web, f_s = 2.68 x 1000/(4.0 x 127.0) = 5.3 N/mm² OK

Beam web

Check unstiffened web capacity with load of 2.68 kN [28.a]

Bearing:  p_b = 260N/mm² (Table 9);  C1 = 27.4 kN [27.e]  C2 = 1.04 kN/mm

Buckling:  p_c = 192N/mm² (Table 17b);  C1 = 48.8 kN;  C2 = 0.769 kN/mm

Minimum required stiff bearing length, L_b = 0mm

Bearing capacity, P_w = C1 + L_b.C2 = 48.8kN  OK

Buckling capacity, P_x = C1 + L_b.C2 = 48.8kN

Deflection

Total deflection = 1.09 x 10^8 /(205,000 x 473) = 1.1 mm (L/2224) OK

Combined bending and shear check (14.c)

Check (f_bc/p_bc)^2 + (f_s/p_s)^2 = 0.025 + 0.000 = 0.025 at 1.25 (<=1.25 OK) [14,c]

Bearings (bearing plate sizing to BS5950-1:2000)

127 x 76 x 13 UB stiff bearing length, b_t = t + 1.6r + 2T = 31.4 mm

R1: 76 x 100 x 5 mm S275 bearing plate

Factored reaction = 1.40 x 2.68 = 3.76 kN

Local design strength of masonry (factored) = 1.25 N/mm^2 (User-entered value)

Factored stress under plate = 3.76 x 1000/76 x 100 = 0.49 N/mm² OK

Bearing plate projection beyond stiff bearing length = (76-31.4)/2 = 22.3mm

Required plate thickness = √(3 x 0.49 x 22.3 x 22.3/275) = 1.64 mm: use 5mm

Factored bending stress in plate = 0.49 x 22.3 x (22.3/2)/(5 x 5/6) = 29.6 N/mm² (p_y=275 N/mm²)

R2: None
### Structural Calculations for Building Control Approval

**Site:** HOLLYSIDE LOCK LANE COX GREEN  
**Job:** EXTENSION  
**Job number:** \[HOLLYSIDE.SBW\]  
**Page 2**  
**Printed 26 Apr 2021 15:23**

#### Beam: Bm 2  
**Span:** 2.7 m.

<table>
<thead>
<tr>
<th>Load name</th>
<th>Loading w1</th>
<th>Start x1</th>
<th>Loading w2</th>
<th>End x2</th>
<th>R1comp</th>
<th>R2comp</th>
<th>Defl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>U T o.w.</td>
<td>0.3</td>
<td>0</td>
<td>L</td>
<td>0.41</td>
<td>0.41</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>U T Roof</td>
<td>2.11 x 3/2</td>
<td>0</td>
<td>L</td>
<td>4.27</td>
<td>4.27</td>
<td>2.19</td>
<td></td>
</tr>
<tr>
<td>U T Wall</td>
<td>3.33 x 2.8</td>
<td>0</td>
<td>L</td>
<td>12.59</td>
<td>12.59</td>
<td>6.45</td>
<td></td>
</tr>
<tr>
<td>U T Floor</td>
<td>2.0 x 5/2</td>
<td>0</td>
<td>L</td>
<td>6.75</td>
<td>6.75</td>
<td>3.46</td>
<td></td>
</tr>
</tbody>
</table>

Total load (unfactored): 48.03 kN  

**Load types:** U:UDL;  
**Load positions are measured in m. from R1;**  
**Load durations:** D: Dead; L: Live

Maximum B.M. = 16.21 kNm (unfactored (all loads applied)) at 1.35 m. from R1  
Maximum S.F. = 24.02 kN (unfactored) at R1  
Total mid-span deflection: 12.31 x 10^8 (E in N/mm², I in cm^4)  

**Steel beam calculation to BS449 Part 2 using S355 steel**

#### SECTION SIZE: 2No 127 x 76 x 13 UB S355

- D = 127.0 mm  
- B = 76.0 mm  
- t = 4.0 mm  
- T = 7.6 mm  
- Ix = 473 cm^4  
- ry = 1.84 cm  
- Zx = 75.0 cm³ (per section)

**Bending**

\[
L/E/ry = 2.70 \times 100/1.84 = 147 \quad \frac{D}{T} = 16.7
\]

Permissible bending stress, \(p_{bc}\) = 134 N/mm² (Table 3b)  
Actual bending stress, \(f_{bc}\) = 16.21 x 1000/(2 x 75.0) = 108 N/mm² OK

**Shear**

Permissible shear stress, \(p_s\) = 140 N/mm² [Table 11]  
Maximum shear in web, \(f_s\) = 24.02 x 1000/(2 x 4.0 x 127.0) = 23.6 N/mm² OK

**Beam web**

Check unstiffened web capacity with load of 24.02/2 = 12.01 kN [28.a]  
Bearing: \(p_b\) = 260 N/mm² (Table 9);  
\(C1 = 27.4\) kN [27.e]  
\(C2 = 1.04\) kN/mm  
Buckling: \(p_c\) = 192 N/mm² (Table 17b);  
\(C1 = 48.8\) kN;  
\(C2 = 0.769\) kN/mm

Minimum required stiff bearing length, \(L_b\) = 0mm  
Bearing capacity, \(P_w\) = \(C1 + L_b \times C2\) = 27.4 kN;  
\(P_x\) = \(C1 + L_b \times C2\) = 48.8 kN

**Deflection**

Total deflection = 12.3 x 10^8/(2 x 205,000 x 473) = 6.3 mm (L/425) OK

**Combined bending and shear check (14.c)**

Check \((f_{bc}/p_{bc})^2 + (f_s/p_s)^2\) = 0.651 + 0.000 = 0.651 at 1.35 (<=1.25 OK) [14.c]

**Bearings**

(bearing plate sizing to BS5950-1:2000)

- 127 x 76 x 13 UB stiff bearing length, \(b_1\) = t + 1.6r + 2T = 31.4 mm; O/A \(b_1\) taken as 107.4 mm

**R1:** 152 x 250 x 5 mm S275 bearing plate

Factored reaction = 1.40 x 24.02 = 33.6 kN  
Local design strength of masonry (factored) = 1.25 N/mm² (User-entered value)  
Factored stress under plate = 33.6 x 1000/152 x 250 = 0.88 N/mm² OK  
Bearing plate projection beyond stiff bearing length = (152-107.4)/2 = 22.3 mm  
Required plate thickness = \(\sqrt{(3 \times 0.88 \times 22.3 \times 22.3/275)}\) = 2.19 mm: use 5mm  
Factored bending stress in plate = 0.88 x 22.3 x (22.3/5) = 52.9 N/mm² (py = 275 N/mm²)

**R2:** None
Sections to be bolted together with tube spacers or suitable alternative connection at max 1.5m c/s
STRUCTURAL CALCULATIONS
FOR BUILDING CONTROL APPROVAL

Site: HOLLYSIDE LOCK LANE COX GREEN
Job: EXTENSION
Job number:
Made by D Turner C.Build E MCABE
Page 4

Printed 26 Apr 2021 15:23

Beam: Bm 3
Span: 4.3 m.

<table>
<thead>
<tr>
<th>Load name</th>
<th>Loading w1</th>
<th>Start x1</th>
<th>Loading w2</th>
<th>End x2</th>
<th>R1comp</th>
<th>R2comp</th>
<th>Defl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>U T o.w.</td>
<td>0.6</td>
<td>0</td>
<td>L</td>
<td>1.29</td>
<td>1.29</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>R T Wall</td>
<td>3.33x3.8</td>
<td>0</td>
<td>3</td>
<td>24.72</td>
<td>13.24</td>
<td>44.7</td>
<td></td>
</tr>
<tr>
<td>R T Roof</td>
<td>2.11x3/2</td>
<td>3</td>
<td>L</td>
<td>0.62</td>
<td>3.49</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>P T Beam: Bm 2 : R1</td>
<td>24.02 [B/F]</td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total load (unfactored): 68.7 kN

Total mid-span deflection: 82.0 x 10^8/EI (E in N/mm², I in cm⁴)

Steel beam calculation to BS449 Part 2 using S355 steel

SECTION SIZE: 2No 180 x 90 x 26 PFC S355

D=180.0 mm  B=90.0 mm  t=6.5 mm  T=12.5 mm  Iₓ=1,820 cm^4  rᵧ=2.89 cm  Zₓ=202 cm^3 (per section)

Bending

Lₑ/rᵧ = 4.30 x 100/2.89 = 149  D/T = 14.4

Permissible bending stress, p_bc = 143 N/mm² (Table 3b)

Actual bending stress, f_bc = 43.3 x 1000/(2 x 202) = 107 N/mm² OK

Shear

Permissible shear stress, p_s = 140 N/mm² [Table 11]

Maximum shear in web, f_s = 34.8 x 1000/(2 x 6.5 x 180.0) = 14.9 N/mm² OK

Deflection

Total deflection = 82.0 x 1e8/(2 x 205,000 x 1,820) = 11.0 mm (L/391) OK

Combined bending and shear check (14.c)

Check (f_s/p_s)^2 + (f_bc/p_bc)^2 = 0.559 + 0.000 = 0.559 at 2.58 (<1.25 OK) [14.c]

Bearings

(bearing plate sizing to BS5950-1:2000)

180 x 90 x 26 PFC stiff bearing length, b₁ = t + 0.8r + T = 28.6 mm; O/A b₁ taken as 57.2 mm

Local design strength of masonry (factored) = 1.25 N/mm² (User-entered value)

R1: 306 x 250 x 15 mm S275 bearing plate

Factored reaction = 1.40 x 33.9 = 47.4 kN

Factored stress under plate = 47.4 x 1000/306 x 250 = 0.62 N/mm² OK

Bearing plate projection beyond stiff bearing length = (306-57.2)/2 = 124mm

Required plate thickness = √(3 x 0.62 x 124 x 124/275) = 10.2 mm: use 15mm

Factored bending stress in plate = 0.62 x 124 x (124/2)/(15 x 15/6) = 128 N/mm² (pᵧ=275 N/mm²)

SuperBeam 7.21g 440612
R2: 306 x 250 x 15 mm S275 bearing plate
Factored reaction = 1.40 x 34.8 = 48.7 kN
Factored stress under plate = 48.7 x 1000/306 x 250 = 0.64 N/mm² OK
Bearing plate projection beyond stiff bearing length = (306-57.2)/2 = 124mm
Required plate thickness = √(3 x 0.64 x 124 x 124/275) = 10.4 mm: use 15mm
Factored bending stress in plate = 0.64 x 124 x (124/2)/(15 x 15/6) = 131 N/mm² (p_y = 275 N/mm²)