**Beam**: **Rear wall support steels** **Span: 7.04 m.**

| | | *Load name* | *Loading w1* | *Start x1* | *Loading w2* | *End x2* | *R1comp* | *R2comp* |
|---|---|---|---|---|---|---|---|---|
| U | D | wall outer | 7 | 0 | | L | 24.64 | 24.64 |
| U | D | wall inner | 5 | 0 | | L | 17.60 | 17.60 |
| U | L | floor | 2.25 | 0 | | L | 7.92 | 7.92 |
| U | D | floor | 1.125 | 0 | | L | 3.96 | 3.96 |
| U | L | roof | 4.5 | 0 | | L | 15.84 | 15.84 |
| U | D | roof | 3 | 0 | | L | 10.56 | 10.56 |
| P | D | Beam: Side wall : R1 | 1.88 [B/F] | 2.4 | | | 1.24 | 0.64 |
| P | L | Beam: Side wall : R1 | 2.79 [B/F] | 2.4 | | | 1.84 | 0.95 |
| | | | | | **Total load: 165.71 kN** | | **83.60** | **82.11** |
| | | | | | | *Dead:* | *58.00* | *57.40* |
| | | | | | | *Live:* | *25.60* | *24.71* |

*Load types: U:UDL P:PL D: Dead; L: Live (positions in m. from R1)*

Maximum B.M. = 147.4 kNm at 3.45 m. from R1

Maximum S.F. = 83.6 kN at R1

Live load deflection = 233.4 x 1e8/EI at 3.52 m. from R1 (E in N/mm$^2$, I in cm$^4$)

Total deflection = 760.9 x 1e8/EI at 3.52 m. from R1

*Steel calculation to BS449 Part 2 using S275 (Grade 43) steel*

**SECTION SIZE** : **305 x 305 x 97 UC Grade 43**

D=307.9 mm B=305.3 mm t=9.9 mm T=15.4 mm $I_x$=22,300 cm$^4$ $r_y$=7.69 cm $Z_x$=1,450 cm$^3$

$L_e$ = 1.2L = 8.45m. $L_E/r_y$ = 8.45x100/7.69 = 110 D/T = 20.0

Permissible bending stress, $p_{bc}$ = 128.1 N/mm$^2$ (Table 3a)

Actual bending stress, $f_{bc}$ = 147.4 x 1000/1450.0 = 101.6 N/mm$^2$ OK

Maximum shear in web, $f_s$ = 83.60 x 1000/(9.9 x 307.9) = 27.4 N/mm$^2$ OK

Check unstiffened web capacities with loads of 83.60 kN and 82.11 kN

Bearing: $p_b$ = 210N/mm$^2$ (Table 9); C1 = 110 kN; C2 = 2.08 kN/mm

Buckling: $p_c$ = 148N/mm$^2$ (Table 17a); C1 = 226 kN; C2 = 1.47 kN/mm

R1: Unstiffened web bearing capacity, $P_w$ = 110kN: no minimum stiff bearing length required

R2: Unstiffened web bearing capacity, $P_w$ = 110kN: no minimum stiff bearing length required

Live load deflection = 233 x 1e8/(205,000 x 22,300) = 5.1 mm (L/1379) OK

Total deflection = 761 x 1e8/(205,000 x 22,300) = 16.6 mm (L/423)

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2$ = 0.629 at 3.52 m. (<=1.25 OK)

**Bearing details**

R2 (119.90kN factored): 413 x 400mm padstone

Masonry: 7N/mm$^2$ brick, class (iii) mortar, normal const/normal mfr

Local design strength (factored) = 3.14/3.5 = 0.90N/mm$^2$ (BS5628-1 Table 2a)

Factored stress under padstone = 119.90 x 1000/413 x 400 = 0.73 N/mm$^2$