Span of beam = 480.0 mm
Overall depth of beam = 100.0 mm
Breadth of beam = 100.0 mm
Clear cover = 25.0 mm
Main bar diameter (TOR) = 8.2 mm
Hanger bar diameter (MS) = 6.0 mm
Stirrup bar diameter (MS) = 6.0 mm
Effective cover at top (d') = 25 + 6/2 = 28 mm
Area of main steel ($A_{n}$) = 105.62 mm$^2$
Area of hanger bar ($A_{w}$) = 56.55 mm$^2$
Area of stirrup ($A_{s}$) = 56.55 mm$^2$
Effective depth of beam (d) = 100 - (25+4.1) = 71 mm (approx.)
Characteristic compressive strength of concrete ($M_{20}$) ($f_{ck}$) = 27.33 N/mm$^2$
Characteristic strength of steel in tension ($f_{ys}$) = 450.00 N/mm$^2$
Characteristic strength of steel in compression ($f_{pc}$) = 275.00 N/mm$^2$
Characteristic strength of stirrup steel ($f_{sy}$) = 230.00 N/mm$^2$
Spacing of stirrups (sv) = 90 mm
Size of Beams = 100 x 100 x 600 mm
Span = 480 mm
Loading = Two point load at 1/3 span on Simply supported beam
CALCULATION FOR LOAD CAPACITY OF BEAM IN FLEXURE AND SHEAR

Equating the strength of compression and tensile zone

\[
\frac{0.36 \times f_{ck} \times b \times x_u + 0.0035(x_u-d') \times E_s \times A_{sc}}{x_u} = 0.87 \times f_{ct} \times A_{st}
\]

\[
0.36 \times 27.33 \times 100 \times x_u + 0.0035(x_u-28) \times 2 \times 10^5 \times 55.55
\]

\[
= 0.87 \times 450 \times 105.62
\]

983 \(x_u + 39,585 (x_u - 28)/x_u = 41,350.23\)

Solving the above equation

\[
\frac{x_u}{x_u} = 34.47 \text{ mm}
\]

CALCULATION FOR FLEXURAL CAPACITY

Flexural capacity of the beam

Compressive force in concrete (\(C_c\)) = \(0.36 \times f_{ck} \times b \times x_u\)

\[
= 0.36 \times 27.33 \times 100 \times 34.47
\]

= 33,914.3 N

Compressive force in compression steel (\(C_{st}\) )

\[
= \frac{(0.0035(x_u-d')/x_u) \times E_s \times A_{sc}}{34.47}
\]

= 39585(34.47-28)/34.47

= 7,430.1 N
CALCULATION OF MOMENT CAPACITY

Taking moment of compressive forces about the centre of tension zone:

Moment due to concrete compressive force
\[ M_{c1} = C_c \times (d - 0.42 \times x_u) \]
\[ = 33,914.3 \times (71 - 0.42 \times 34.47) \]
\[ = 19,16927 \text{ N mm} \]

Moment due to compressive force in steel
\[ M_{c2} = C_s \times (d - d') \]
\[ = 7,430.1 \times (71 - 28) \]
\[ = 3,19439 \text{ N mm} \]

Total moment \( M = M_{c1} + M_{c2} \)
\[ = 22,36420 \text{ N mm} \]

Load carrying capacity of beam due to flexure
Moment due to applied load \( (2W_u) M = W_u \times 160 \)

Maximum load that can be applied on beam \( W_u = \frac{22,36420}{160 \times 1000} \times 2 \)

Capacity of load due to flexure = 27.96 kN

SHEAR CALCULATION

As per the IS:456 - 1978
The ratio of steel vs area of beam gives
\[ \frac{A_s \times 100}{b \times d} = \frac{(105.62 \times 100)/100 \times 71}{1.487} \]
The design shear strength $\tau_c$

$$\tau_c = 0.718 \text{ N/mm}^2$$

Shear capacity of concrete

$$= 0.7182 \times b \times d$$
$$= 0.7182 \times 100 \times 71 \text{ N}$$
$$= 5097.8 \text{ N}$$

Shear capacity of stirrups

$$= (0.87 \times f_{sv} \times A_{sv} \times d) / s_v$$
$$= (0.87 \times 230 \times 56.55 \times 71) / 90$$
$$= 8926.8 \text{ N}$$

Total shear

$$= 5097.8 + 8926.8 = 14024.6 \text{ N}$$

Total load capacity on the beam due to shear

$$= 14024.6 \times 2 / 1000 = 28.05 \text{ kN}$$

$$= 28.05 \text{ kN}$$