# DESIGN OF DIAGONAL REINFORCEMENT FOR COUPLING BEAM

## AS PER IS 13920-2016

*Input / Defaults*

$BeamNo$ : B2

$B := 450\ mm$ ---------- Width of the Beam

$D := 900\ mm$ ---------- Depth of the Beam

$fck := 25\ MPa$ ---------- Grade of Concrete

$fy := 415\ MPa$ ---------- Grade of Reinforcement

$Cc := 25\ mm$ ---------- Nominal Cover to Beam Tension Reinforcement

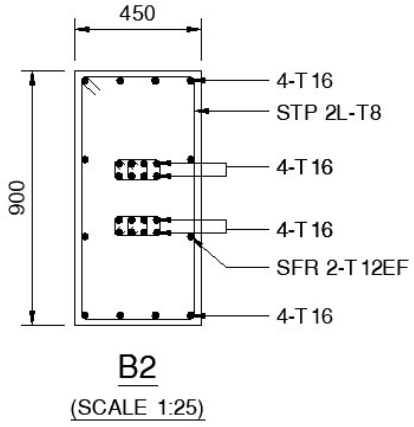
$Es := 200000\ MPa$ ---------- Modulus of elasticity of reinforcement

$Vue := 471.989\ kN$ ---------- Earthquake Induced shear

$Ls := 1000\ mm$ ---------- Clear span of Beam

$deff := 845\ mm$ ---------- Effective Depth of the Beam

*Beam Cross Section*




B2

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*Diagonal reinforcement*

$\phi 1 := 16\ mm$ ---------- Diameter of Diagonal Reinforcement

$N1 := 8$ ---------- No of Diagonal Reinforcement

$$Ast := \frac{\pi \cdot \phi 1^2}{4} \cdot N1 = \left(1.608 \cdot 10^3\right)\ mm^2$$ ---------- Area of Tension Reinforcement Provided

*Checking for Coupling Action*

$Ls := 1000\ mm$ ---------- Clear span of Beam

$D := 900\ mm$ ---------- Depth of the Beam

$D' := D - \left(2 \cdot Cc\right) = 850\ mm$

$Vue := 471.989\ kN$ ---------- Earthquake Induced shear

$$Tce := \frac{Vue}{\left(B \cdot D\right)} = 1.165\ MPa$$ ---------- Clause 10.5.2

$$Tcep := 0.1 \cdot Ls \cdot \frac{\sqrt{fck \cdot MPa}}{D} = 0.556\ MPa$$ ---------- Clause 10.5.2

$$Check := \left\| \begin{array}{l} \text{if } Tce > Tcep \\ \quad \| \text{“Coupling Beam”} \\ \text{else} \\ \quad \| \text{“Regular Beam”} \end{array} \right\| = \text{“Coupling Beam”}$$

---------- Check for Coupling Beam

## *Design of Diagonal Reinforcement*

$$\alpha := \operatorname{atan}\left(\frac{D'}{Ls}\right) \cdot \frac{180}{\pi} = 40.365$$

$$Adr := 1.5 \cdot \frac{(Vue)}{1.74 \cdot fy \cdot \sin\left(\alpha \cdot \frac{\pi}{180}\right)} = \left(1.514 \cdot 10^3\right)\ mm^2$$ ---------- Clause 10.5.2

## *Diagonal reinforcement provided*

$\phi 1 := 16\ mm$ ---------- Diameter of Diagonal Reinforcement

$N1 := 8$ ---------- No of Diagonal Reinforcement

$$Ast := \frac{\pi \cdot \phi 1^2}{4} \cdot N1 = \left(1.608 \cdot 10^3\right)\ mm^2$$ ---------- Area of Tension Reinforcement Provided

$$Check := \left\| \begin{array}{l} \text{if } Ast > Adr \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Revise”} \end{array} \right\| = \text{“Ok”}$$

## *Note:*

1. Design of Longitudinal and shear reinforcement would be as as Regular beam. Longitudinal and Shear reinforcement would be designed for load combinations other than having Earthquake load case.
2. Design of Links for Diagonal reinforcement would be as per column special confining links spacing not exceeding 100mm.

## *RCDC Output - Design Calculation Report*

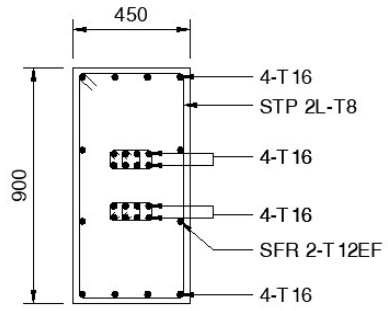
| | | | |
|---|---|---|---|
| Group | | : | **G2** |
| Beam No | | : | **B2** |
| Analysis Reference (Member) | 15 m | : | 1304 |
| | 20 m | : | 1404 |
| Beam Length | | : | 1000 mm |
| Breadth (B) | | : | 450 mm |
| Depth (D) | | : | 900 mm |
| Effective Depth (d) | | : | 845 mm |
| Design Code | | : | IS 456 |
| Beam Type | | : | Coupling Beam |
| Grade Of Concrete (Fck) | | : | M25 N/sqmm |
| Grade Of Steel | | : | Fe415 N/sqmm |
| Clear Cover (Cmin) | | : | 25 mm |
| Es | | : | 2x10^5 N/sqmm |

**Check for coupling action**

| | | | |
|---|---|---|---|
| Clear Span of Beam, (Ls) | = | 1000 | mm |
| Beam Depth, (D) | = | 900 | mm |
| D' | = | 850 | mm |
| Shear, (Vue) | = | 471.989 | kN |
| Tce | = | Vue/BD | |
| | = | 1.165 | N/sqmm |
| Tcep | = | (0.1xLsxsqrt(Fck))/D | |
| | = | 0.556 | N/sqmm |
| | | Tce > Tcep | |
| | | Hence, Beam is 'Coupling Beam' | |

**Design of diagonal reinforcement**

| | | | |
|---|---|---|---|
| Angle with horizontal, (α) | = | 40.365 | deg |
| Adr | = | 1514 | sqmm |
| Reinforcement provided | = | 4-T16 | |
| | | 4-T16 Both diagonals | |




B2

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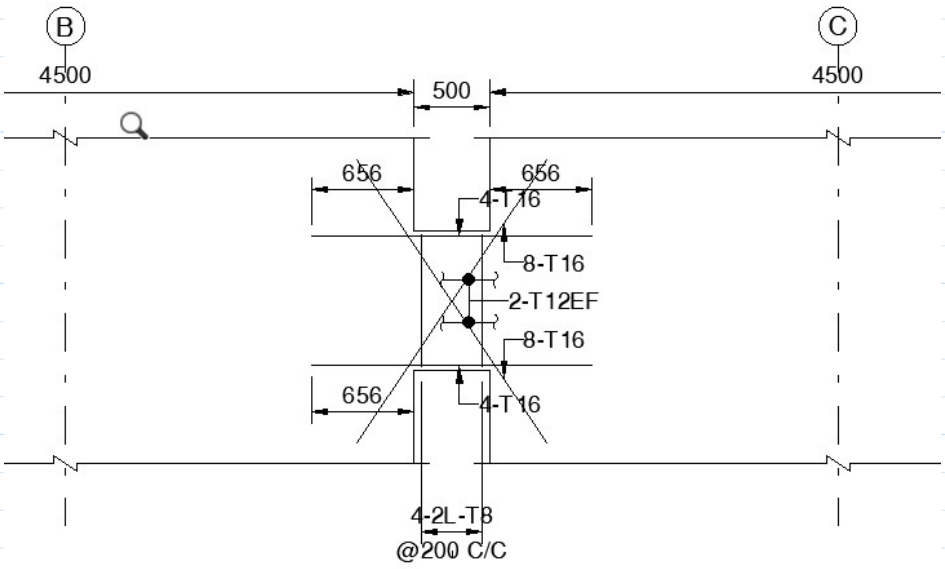


B2:450x900

(SCALE: H = 1:50 / V = 1:50)