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Increase the shear load carrying capacity of reinforced concrete beam by providing inclined multiple stirrups in shear zone.

Swapnil H. Patil[1],

[1] *Lecturer, Civil Engineering Department, St. John College of Engineering & Technology, Palghar, Maharashtra, India.*

Abstract

The reinforced concrete beams are generally fails in shear so to overcome this researcher provides inclined stirrups in R.C.C. beam. R.C. beams are shows different behaviour & it fails in shear as compared to bending which is not a safe mode of failure The shear failure of beam is unexpected or abrupt without advanced warning which creates cracks in beam. This is new technique in which both end of the stirrups are bent horizontally & it tie or weld to the top & bottom steel reinforcement. Three different types of stirrups are introduced in this literature. The main purpose of this literature is to identifying the economical shape of stirrup to carry more shear load at lowest cost .

Key Words: Stirrups, R.C.C. Beams, Shear, Loads, Failure, Cracks

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1.INTRODUCTION

Reinforced concrete beams are generally carry the load came from floor (dead load of slab, furniture, wall & live load) & it transfer to the column. So at a time of transferring load excess shear load may be cause to unexpected failure of the beam in shear which is unsafe mode of failure of beam. The shear failure mechanism is depends upon shape & size of member, type of loading conditions & properties of the materials which is used to make that structural member. In ULM method if the bending moment & shear is exceed the limits then the tensile cracks are occurs in tension zone & diagonal cracks are occurs in shear zone of beam which are responsible for failure of r.c.c. beam. Normally the shear cracks are occurs at middle height of beam in shear zone at both support @ 45^0 . Towards the compression zone of r.c.c. beam. So to overcome this shear reinforcement is provided in typical three forms: 1) Stirrups, 2) Inclined bent up bars, 3) Stirrups & bent up bars combine.

2.ACI CODE USE FOR SHEAR DESIGN OF BEAM.

As per ACI code 2011 the beam is design for shear failure is based on following steps.

$$Vu \leq \Phi Vn$$

Where Vu is the total shear force apply at the given section of the beam,

Vn = Vc + Vs It is nominal shear strength = sum of the concrete & the steel if present.

So for the vertical stirrups $Vu < \Phi Vn + (\Phi A_v f_{yt} d / s)$

& for Inclined stirrups $Vu < \Phi Vn + [(\{ \Phi A_v f_{yt} d \} \{ \sin \alpha + \cos \alpha \}) / s]$

A_v is the area of one stirrup, **α** is the angle of stirrup with horizontal, S is the spacing between the stirrups. The nominal shear strength of the concrete can be simplified as:

$Vc = 0.17\lambda\sqrt{\sigma_c}\, b_w d$ .... Where b & d are the dimensions of the section. λ = 1.0 this formula is in metric units.

3.TESTING OF BEAMS

In this study researcher is tested three beams which are based on experimental investigation. The beams were tested under two point loading in compressive testing machine. The compressive strength of concrete is measured according to ASTM c – 192-57. The compressive strength of concrete is measured for 28 days. The concrete compressive strength result range between 34.5 N/MM^2.

BEAM NO.	SHEAR REINFORCEMENT		STEEL CAGE WEIGHT KG.
	VERTICAL	INCLINED	
B 1	8 MM TOR.- 200MM C/C	---	235
B 2	----	10 MM TOR.- 175MM C/C	265
B 3	----	10 MM TOR.-200MM C/C	255

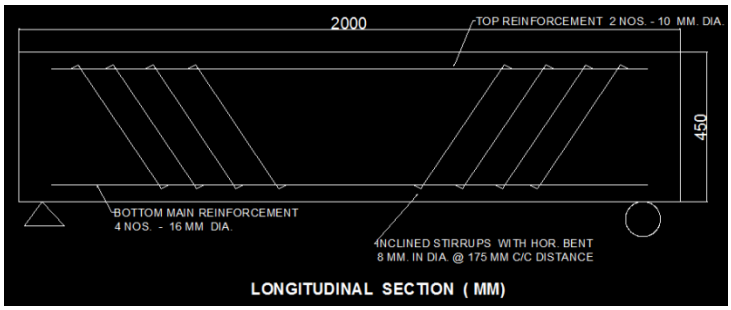


Fig. (a)

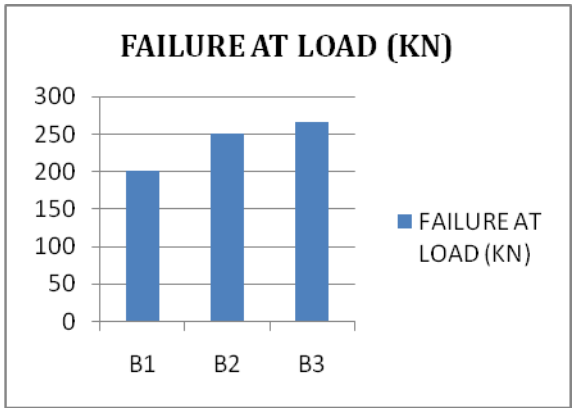
In this research three reinforced concrete beams are prepared B1, B2, and B3. With same dimension as Length=2000 mm, width=200 mm, Depth 450 mm. All beams are design with 2 nos.- 10 mm Dia. Top reinforcement & 4 nos.-16 mm Dia. Bottom reinforcement. With inclines stirrups of Dia. 8 mm. In Beam B1 vertical stirrups are provided @ 200 mm c/c distance. Where other two beams B2, B3 inclined stirrups are provided 8 MM @ 175 mm c/c distance.

The surface of beam specimen is painted with colour so that at a time of failure the cracks are detected easily & clearly. After 28 days of casting beams are ready for testing of compressive test. Concrete beams are placed horizontally in the specimen under simple loading conditions. These beams are design for fails in shear not in flexural. To ensure the cracks two point loads are applied with shear span less than 2.5d. d is effective depth of beam. The load increment is 20 kn. for reasonable time interval for measuring the deflection in beams, cracks in the beams etc.

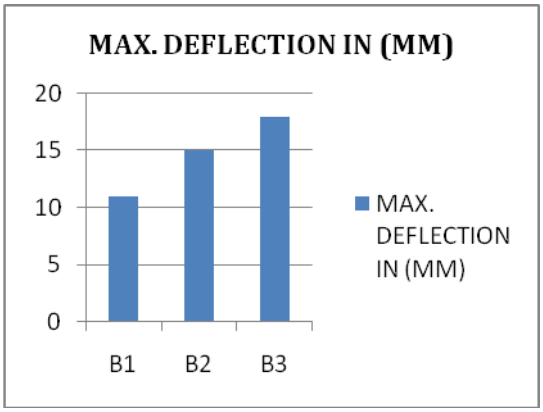
4.TEST RESULT

The **beam no.01** fails typically by shear at load of 200 kn. Beam 02 shows some micro cracks in early process. These cracks are get widen as the load is increases. These cracks are clearly visible at the stage of loading of 100 – 150 kn. Numbers of flexural cracks are appeared in moment zone at loading range @ 100-150 kn. & it get increased when we increased the load. Similarly other beams **Beam 02** & **Beam 03** are went into same stages up to their failure.

The beam was fails in shear with some amount of deflection where shear cracks are developed as increase the load. These cracks are increase as increase in External loading. In Beam no. 01 vertical stirrups are provided, this beam it fails in shear with loading (Two point load) of @ 200 kn. In other case for Beam 02 Inclined stirrups are provided with cross bracing which was fails at 250kn. External loading. And for Beam no.03 inclined stirrups are provided with vertical bracings which were fails at 265 kn. Load. As we observe by graph so we can conclude here that the beam with vertical stirrup shows the deflection due to loading is 11mm, the deflection for beam no.02 is 15mm when load was 250kn & the deflection is 18 mm for beam no. 03 for loading of 265kn. By using two vertical bracing in inclined stirrups.



Graph (a)



Graph (b)

5. CONCLUSION

In this research the shear reinforcement is prepared in various shapes like inclined shear reinforcement with vertical bracings, cross bracings etc. This system of inclined stirrups is improve the shear load carrying capacity of beam. Researcher observer that width & length of cracks in beam by using inclined stirrups is less than using of vertical stirrups. Researcher also observe that the provision of multiple inclined stirrups will give more shear load carrying capacity than providing cross bracing inclined stirrups. These methods have only one drawback that the installation of inclined stirrup is very hectic & difficult at a time of preparation of steel cage for beam.

6.REFERENCES

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