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EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOUR OF WAVERY MILD STEEL AND HYSD BAR BEAMS

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***Abstract*—** Concrete has become the world's most common building material for construction. Concrete with reinforcement is called RCC . Recently HYSD bars are used as reinforcement. The major problem in using of HYSD bars is corrosion, HYSD bars are corroded shortly due to initial pretension because of introduction of transverse and longitudinal ribs. Mild Steel bars are also used as reinforcement but the bond strength between concrete and the reinforcement of MS bar is less than HYSD bars. In order to overcome the corrosion effect and bond strength improvement of steel, it is provided with the provision of C bars or wavery bars. Influence of flexural behaviour on wavery bar with (18 mm deformed axis) reinforced concrete beam is compared with the flexural behaviour of mild steel(wavery),mild steel, HYSD reinforced concrete beams. The Modulus of rupture, central deflection, mode of failure is compared with the various rebar configuration. The results indicated that the wavery-bars(both MS and HYSD) are more ductile than HYSD and Plain mild steel rebars. However ultimate load carrying capacity of C-bar was comparatively same as HYSD rebars and higher than Mild steel Bars. The failure patterns for wavery bars was Flexural failure with different crack pattern which was horizontal crack pattern and looked a new type of failure in the case of beams. The flexural strength of wavery-bar reinforced concrete is increased by proper confinement (shear Reinforcement) so that it will attain the maximum ultimate loads.

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I. INTRODUCTION

Wavery bars are used as reinforcement in beams instead of normal straight bars . Mild steel and HYSD bars were made as wavery with a crown depth of 18mm and spacing of 300mm for each curve. Three continuous curves are provided on each bar In this project, beams with a size of 1000x150x150mm are casted for a concrete grade of M25 mix design and the reinforcements are provided by placing 20mm cover blocks at the bottom of the mould Beams can be designed to give optimized performance characteristics for a given set of load, usage and exposure conditions consistent with the requirements of cost, service life and durability.The experimental program comprise the effect of wavery bars on flexural strength , which was studied according to the comparison of MS wavery bars and HYSD wavery bars with normal MS bars and HYSD bars. Beams with wavery bars as reinforcement has several advantages like improved deflection characteristics and comparatively similar load carrying capacity, improved corrosion and better bond strength between concrete and steel and different crack pattern and better ductility.

II. OBJECTIVE

1. The main objective of this study is to do an experimental investigation on the properties and the behavior of concrete beam with wavery mild steel bars as reinforcement and designed as doubly reinforced beam.
2. To reduce the corrosion effect in beams which is major problem.

3. Improve the deflection properties in beams.
4. Also to reduce the depth of the beam by considering the deflection values

III. EXPERIMENTAL PROGRAM

Eight beams were casted and tested in laboratory. Beams were cured for a period of 28 days and studied the flexural strength .Type of beams casted were,

1. Beams reinforced with Mild steel rebars – MSB
2. Beams reinforced with wavery mild steel (18 mm deformation) – WMSB.
3. Beams reinforced with HYSD rebars- HYSDB.
4. Beams reinforced with wavery HYSD bars (18 mm deformation) -WHYSDB

Test materials are given below:

A. Cement

Ordinary Portland cement (53 grade) whose specific gravity is 3.15, initial setting time is 35 minutes, final setting time is 10 hours is used.

B. Fine aggregate

In this study zone II sand is used whose specific gravity is 2.86, fineness modulus is 2.1, bulk density is 33% is used.

C. Coarse aggregate

Coarse aggregate of size 20mm is used which has specific gravity 2.8, fineness modulus 4.76 as per IS 383.

D. Water

Portable water free from harmful oils, alkalis, sugar, organic impurities are used for proportioning and curing of concrete.

E. Steel reinforcement

Steel used were 12 mm bars Fe415 grade and 12mm and 8mm bars Fe 250 grade

F. Beam design

1.Design of HYSD bar beam.
2.Design of Mild Steel bars beam

G. Mix design (M25)

TABLE 1 : BATCHING OF AGGREGATES

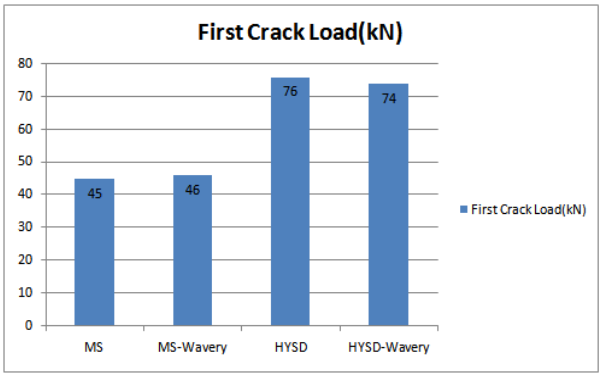
Cement (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Water (litres)	W/C
448	732.16	1075.2	197	0.44

IV. RESULTS AND DISSCUSSION

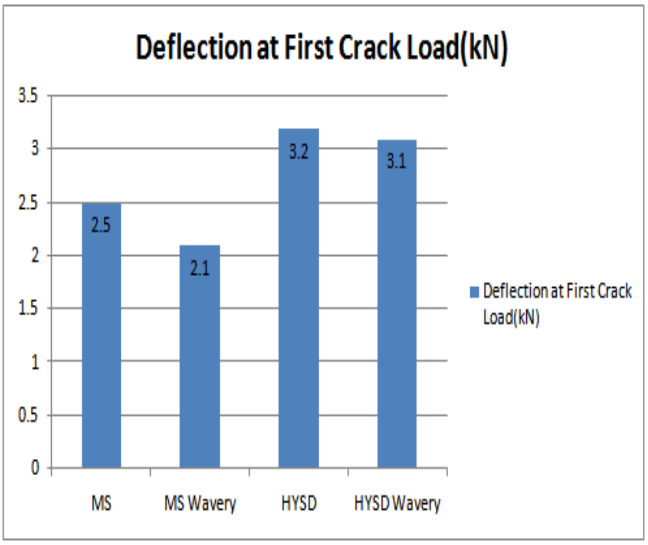
The test was carried on beam specimens, the test results are given below

TABLE 2 : MODES OF FAILURES AND DEFLECTION

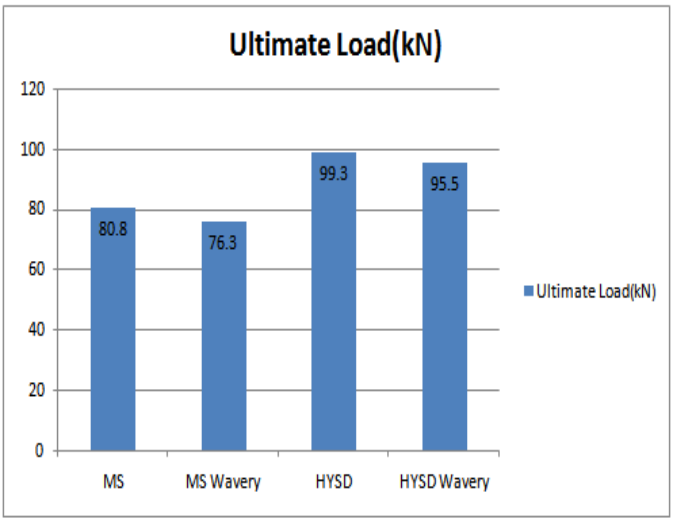
S.NO	Type of specimen	First crack load (kN)	Deflection at First crack load (mm)	Mode of failure	Failure Region
1.	Beams with Mild Steel rebar (MSB)	45.3	2.5	Flexural Crack	Central region in tension zone
2.	Mild steel wavery bar beam (WMSB)	46.2	2.1	Flexural crack followed by shear crack	Crack arising from the bottom of the middle third portion
3.	Beams with Spiral rib HYSD rebars (HYSDB)	76.1	3.2	Flexural Crack followed by shear crack	Middle $1/3^{rd}$ region in tension zone
4.	Beams with wavery HYSD bars (18 mm deformation) (WHYSDB)	74.8	3.1	Horizontal crack	Horizontal crack arising from the middle third portion of the beam



Graph 1:First crack load.



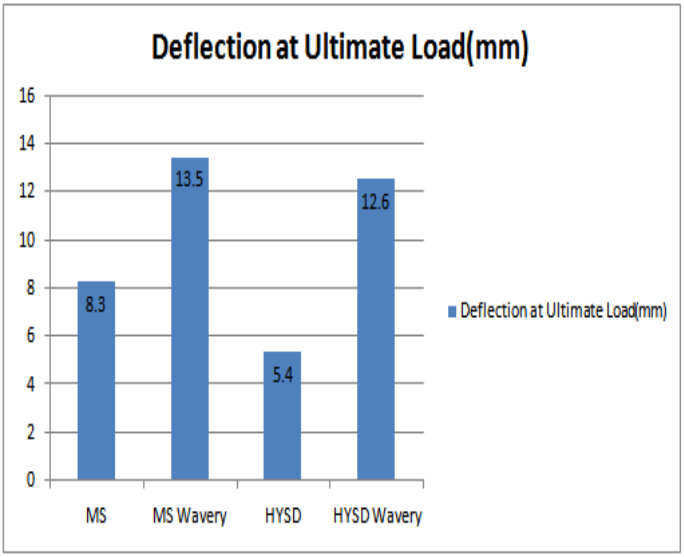
Graph 2: Deflection at first crack load.



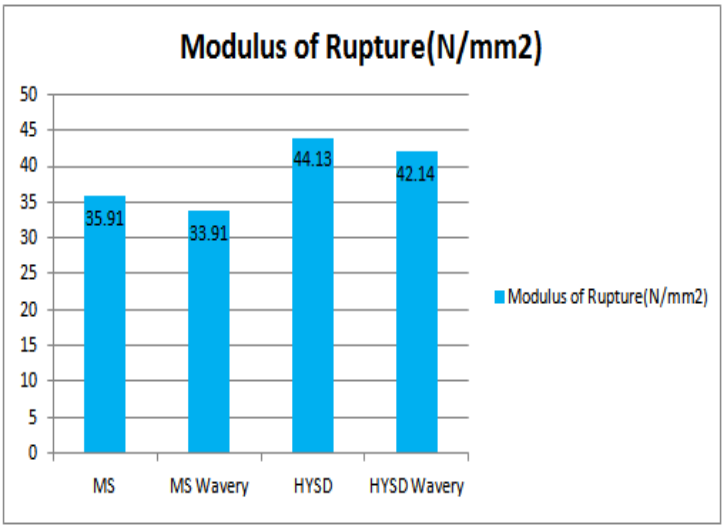
Graph 3: Ultimate load

TABLE 3: MODULUS OF RUPTURE DUE TO CRACKING LOAD

S.NO	Type of specimen	Ultimate Load (kN)	Deflection at Ultimate load (mm)	Modulus of rupture (MPa)	Mode of failure
1.	Beams with Mild Steel rebar(MSB)	80.8	8.3	35.91	Flexural Crack
2.	Mild steel wavery bar beam (WMSB)	76.3	13.5	33.91	Diagonal Shear Crack developed from centre of span to support and sudden fracture of specimen
3.	Beams with Spiral rib HYSD rebars (HYSDB)	99.3	5.4	44.13	Flexural-Shear Crack (conical failure)
4.	Beams with wavery HYSD bars(18 mm deformation) (WHYSDB)	95.5	12.6	42.14	Horizontal crack arising from the middle third portion of the beam and extending towards the other two thirds



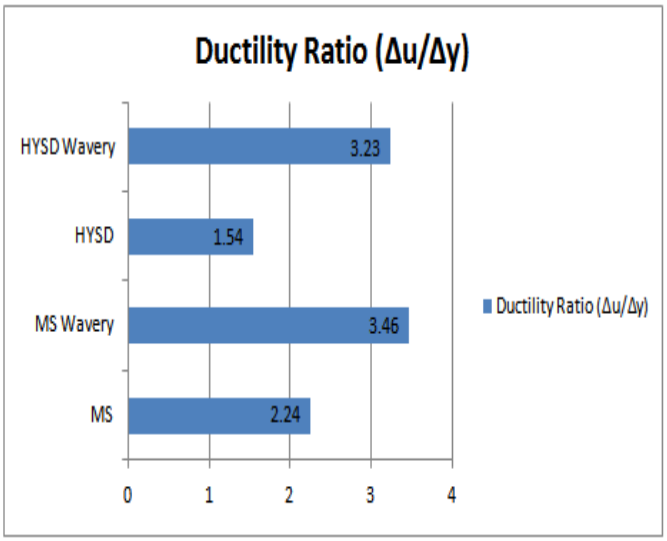
Graph 4: Deflection at ultimate load



Graph 5 : Modulus of rupture

TABLE 4 : DUCTILITY RATIO

Beam specification	Yield stage deflection Δy (mm)	Ultimate stage Deflection Δu (mm)	Ductility ratio Δu/Δy
MSB	3.7	8.3	2.24
WMSB	3.9	13.5	3.46
HYSDB	3.5	5.4	1.54
WHYSDB	3.9	12.6	3.23



Graph 6: Ductility ratio.

V. CONCLUSION

From the above experiment it was inferred that,

1. When compare to HYSD and Plain MS bars and wavery MS higher first crack load of wavery HYSD bar beam was found.
2. Changes in configuration of steel Bars may greatly influence the flexural capacity of the member.
3. Irrespective of the rebar surface configuration, beams made of different types and rebars exhibit similar load-deflection behaviour except for beams with spiral rib HYSD rebars.
4. Wavery HYSD bar Beam specimens found Improved Ductility than MS and HYSD.
5. Flexural failure with different crack pattern which was horizontal crack pattern and looked a new type of failure in the case of beams and also depicts that, the flexural stresses within the body resisted by crest of the profile and thus distribute these stresses with a way horizontal towards the trough of the profile.
6. Crack patterns depicts that, shear failure did not occur in the wavery MS and wavery HYSD.
7. Tested beams were broken and exposed the Wavery bars for any change of its configuration due to the application of load. It was found that, the bar configuration slightly straightened under the loaded region which depicts a pitch length and offset of wave from axis of bar is important parameter to consider.

REFERENCES

[1] H. Dwairi, M. Dawood and S. Rizkalla"Shear and Flexural Behavior of Concrete Members Reinforcedwith MMFX Steel". MMFX Technologies CorporationIrvine, California, U.S.A.

[2] M. A. Mansur, M. S. Chin, and T. H. Wee "Flexural Behaviour of High-Strength Concrete Beams". 94-S60, Structural Journal, Volume 94, Issue 4, pages: 663-674November 1, 1997.

[3] P. S. Mangat, M. S. Elgarf "Bond characteristics of corroding reinforcement in concrete beams". Materials and Structures Journal ISSN: 1359-5997, E-ISSN: 1871-6873, Volume 32, Issue 2, pp 89-97, March 1999.

[4] Pritpal S. Mangat and Mahmoud S. Elgarf "Study on Flexural Strength of Concrete Beams with Corroding Reinforcement". 96-S17, Structural Journal Volume 96, Issue 1, pages: 149-158 January 1, 1999.

[5] Tarek U. Mohammed, Nobuaki Otsuki, and Makoto Hisada "Corrosion of Steel Bars with Respect to Orientation inConcrete". ACI Materials Journal, Title no. 96-M19, March-April 1999.