International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

Impact of Reinforcing Bar Characteristics on Flexural Strength of Beams

Saqib Yousuf, Vishal Yadav, Sandeep Singla

Abstract: Reinforced concrete (RC) frame members under seismic loading are likely to experience large inelastic deformation, therefore, sufficient ductility Brittle mode enhancements must be avoided to enhance the potential for energy dissipation. These components are satisfied and satisfied after the earthquake. The event depends to a large extent on the nature of the materials used in its manufacture. That is, steel and concrete. This research is concerned with Strengthen steel in bending behavior until failure. When the capacity design for the reinforced concrete buildings or structures is sufficient real capacity does not exceed the actual design capabilities. In addition, RC member is a large inflexible deformation is expected to produce sufficient seismic dissipation. Because of the ability to bend. The post-productivity performance of RC members is mainly controlled by steel rods, which have some special characteristics. Performance requirements strength of yield, strength of tension and elasticity the steel manufacturing method. Thirty years of bending test Reinforced concrete beam was observed using carefully controlled steel bars. The reliable bending behavior and YS and UTS values must be within a narrow range around the value used design Members. If these values are greater than the specified value, they may cause a crisp cut failure instead of more bending and perfect bending failure modes.

Keywords: Flexural behavior, Ultimate loads, Flexural Strength, Beams.

I. INTRODUCTION

Reinforced concrete frame (RC) elements under seismic loads can undergo large non-elastic deformities, so sufficient softness is necessary to avoid fragile failure conditions and improve energy dissipation potential. The satisfactory performance characteristics of these RC components in seismic events depend largely on the properties of the materials used in their manufacture, namely steel and concrete. This study focuses on the effects of steel properties and their processes on the bending properties of the beam. Paper are fine and satisfactory. Author (s) can make rectification in the final paper but after the final submission to the journal, rectification is not possible.

Revised Manuscript Received on December 30, 2019.
***** Correspondence Author

Saqib Yousuf*, M-Tech, Department Of Civil Engineering Rimt University, Punjab India.

Vishal Yadav, Assistant Professor Department Of Civil Engineering Rimt University, Punjab India.

Dr Sandeep Singla, Professor & Head, Department Of Civil Engineering, Rimt University, India.

II. FLEXURAL BEHAVIOR OF BEAMS REINFORCED

The steelmakers usually meet the minimum specifications, the nominal yield strength of steel bars in many countries can significantly exceed the steelmaking process. This increase in yield strength adversely affects the bending properties of the beam designed for tension control and reduces the basic property of the aseismic structure, ductility.

The bending behavior of reinforced concrete (RC) beams were investigated experimentally and analyzed by studying the bending moment-curvature relationship and the strain of steel. The level of main variable at which the nominal value is compared to the yield stress of steel. the high yield stress values decrease the ductility of the member and disturbs the tension balance during the phase.to reach the desired value of ductility of the member appropriate corrections of design should be taken under consideration for yield stress.

Much attention has been given to the effects of changes in concrete strength and properties on the response of reinforced concrete structures, but little information is available on the impact of changes in flexural strength. This lack of knowledge may be due to the assumption that steel manufacturers are always adhering to the minimum norms. However, the mechanical properties of the steel may exceed the minimum nominal strength value of the particular steel grade. This occurs in many places as manufacturing methods differ between steel makers. The mechanical properties of the steel depend on the manufacturing technology, the chemical composition, the machining of the steel bars and the heat treatment method. Earthquake-resistant standards have been developed to prevent steel cracking during earthquakes, increasing the seismic energy absorption of structures and preventing collapse. The strength of the steel should be high, enough ductility and minimum changes in yield strength to be subjected to plastic strain inelastic deformation cycles. In this regard, most international standards outline and manage the mechanical performance requirements of steel bars used in seismic systems.

III. EXPERIMENTAL INVESTIGATION

In the light of the rising construction engineering in Srinagar to meet maintainable development imagined in vision, the structural stability position of buildings and other civil engineering structures are indeterminate. Contractors, local people buy the steel from local market and use it without an examination or test. It is observed that most times manufacturers supply good quality and well tested reinforcing steel to companies and contractors who are known for being aware with the material and may examine it. the manufacturing steel companies make the poor quality, less durability steel for the local market.

The structural strength largely depends upon the reinforcement/steel, concrete is stronger in compression but weak in tension, steel is stronger in tension so steel gives the tensile strength to the structure the structure undergoes tensile and compression forces so we must ensure the steel is made of good quality material before using it .many incidents have happened across India where structure has failed due to the poor quality steel used in the structure.

IV. OBJECTIVES

- To determine the Flexural Strength
- Beam cracking under different loads on multiple beams using 10mm and 12mm dia bars
- To determine deflection of beams under average ultimate loads

V. METHODOLOGY

A. General

Concrete beams of Twenty-four in number where prepared with a constant size of .15m x .25m x 1.8m each beam has 4 X 10mm and 12mm dia bars and have been used for the beam samples. Shear bars (stirrups) of 8mm dia were used to hold the Beams together. Reinforcing bars from four different sources available in Srinagar have been used in the tests, 6 beams were cast from the each source 3 of 10mm dia steel and 3 of 12mm dia steel Formwork was made suitably according to pre-determined sizes and oil was applied to internal walls of formwork uniformly After arranging steel cages, they were put into the formwork which were arranged into 4 different groups and source of reinforcing bars. Then concrete was poured into the formwork according to predetermined consistency and mix ratios.

After steel cages were placed in molds, concrete was poured and then vibrator was used for adequate compaction after few days' formwork was removed from the members and marked with different no.'s. Preparing of the reinforced concrete beam samples for conducting of tests, beams were designed based on IS 456.

B. Preliminary Data

Table-1: Pre-calculated design data.

	Design data	Values
1	F_y	415 N/mm²
2	F_{ck}	30 N/mm²
3	Effective length (L) = overall length (1800mm) – over hangs (150mm x 2)	1500 mm
4	W	150 mm
5	h	250 mm
6	d = h- conc cover- ½ bar – stirrup =2500-25-6-8 = 211	211 mm
7	As (12 mm Ø) = (3.14 x 6²) 2 =	226.08 mm²
8	A's (12 mm Ø) = (3.14 x 6²) 2 =	226.08 mm²
9	As (10 mm Ø) = (3.14 x 5²) 2 =	157 mm²
10	A's (10 mm Ø) = (3.14 x 5²) 2 =	157 mm²
11	Steel rebars design strength = F_y / Υ_m = 415/1.15	360.86 N/mm²
12	Concrete design strength = F_{ck} / Υ_{mc} = 30/1.5	20 N/mm²

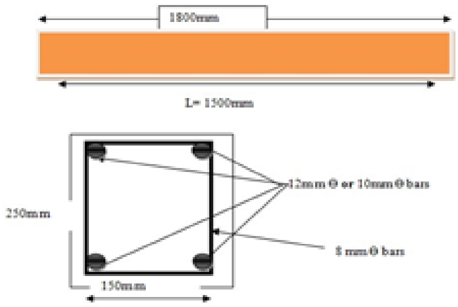


Figure-1: Dimensions of the reinforced concrete beam.

X12 Beams

M = $WL^2/8$ = 56.9 KNm

Design load = 111.8 KN

Flexural strength of the beam (σ) = Fl/bd^2

= 25.1 N/mm²

X10 Beams

M= $WL^2/8$ = 40.2 KNm

load (F) = 78.2 KN

(σ) = Fl/bd^2

= 17.6 N/ mm²

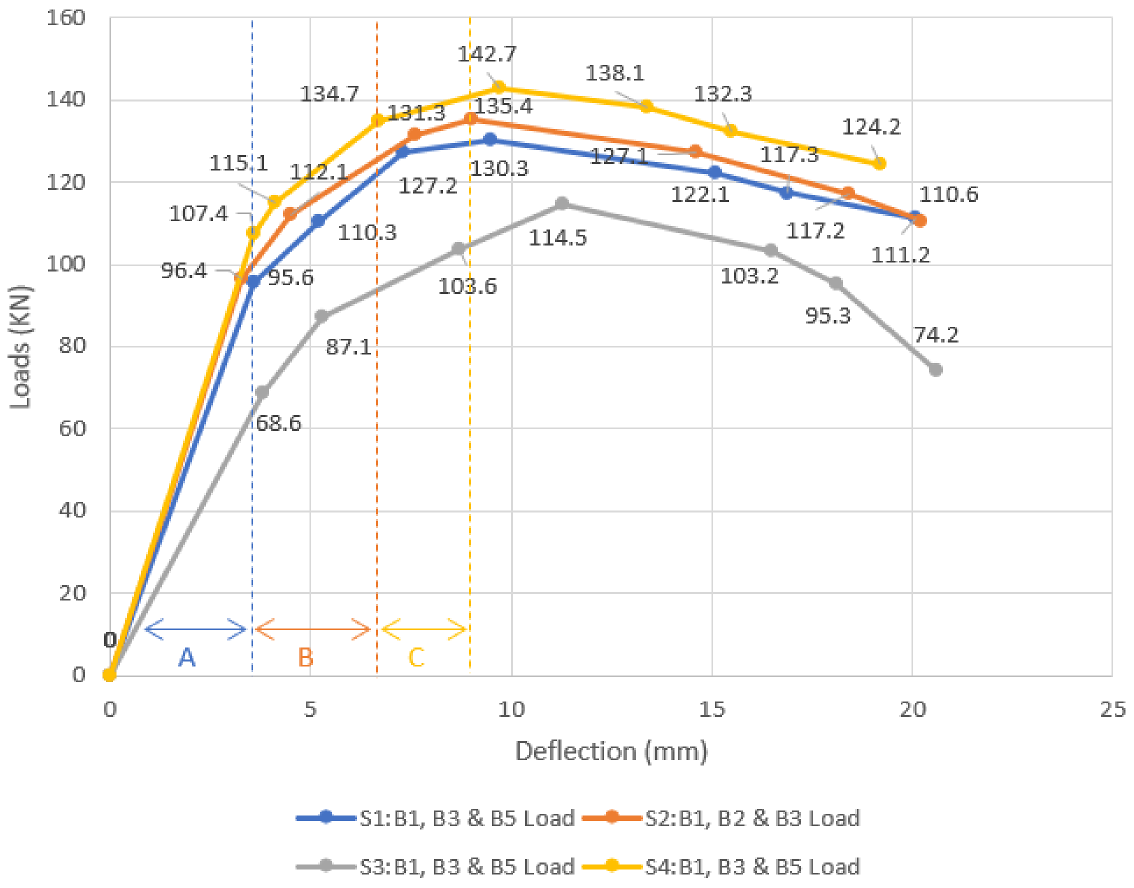
M20 cement concrete with 1:1.5:3 ration was taken, having characteristic strength of 20N/mm², with water cement ratio of .45 and slump of 60mm. After curing it for 28 days, further curing was stopped for reinforced concrete beam samples and water was cleared and any other substances on the surface were also cleaned, then adjusted for the whole length of the beam.

VI. EXPERIMENTAL RESULTS

A. Ultimate loads

Table-2: Reinforced concrete beam (12mm dia reinforcement) avg ultimate load - deflection test results.

Sample 1: Beam 1, 3 & 5		**Sample 2: Beam 1, 3 & 5**		**Sample 3: Beam 1, 3 & 5**		**Sample 4: Beam 1, 3 & 5**		
Deflection (mm)	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Status Failure**
0	0	**0**	**0**	**0**	**0**	**0**	**0**	
3.6	95.6	3.3	96.4	3.8	68.6	3.6	107.4	Load at 1st crack (Pcr)
5.2	110.3	4.5	112.1	5.3	87.1	4.1	115.1	2nd crack
7.3	127.2	7.6	131.3	8.7	103.6	6.7	134.7	Yield load (Py)
9.5	130.3	9	135.4	11.3	**114.5**	9.7	142.7	**Ultimate load (Pu)**
15.1	122.1	14.6	127.1	16.5	103.2	13.4	138.1	Descending load 1st
16.9	117.3	18.4	117.2	18.1	95.3	15.5	132.3	2nd
20.1	111.2	20.2	110.6	20.6	74.2	19.2	124.2	3rd

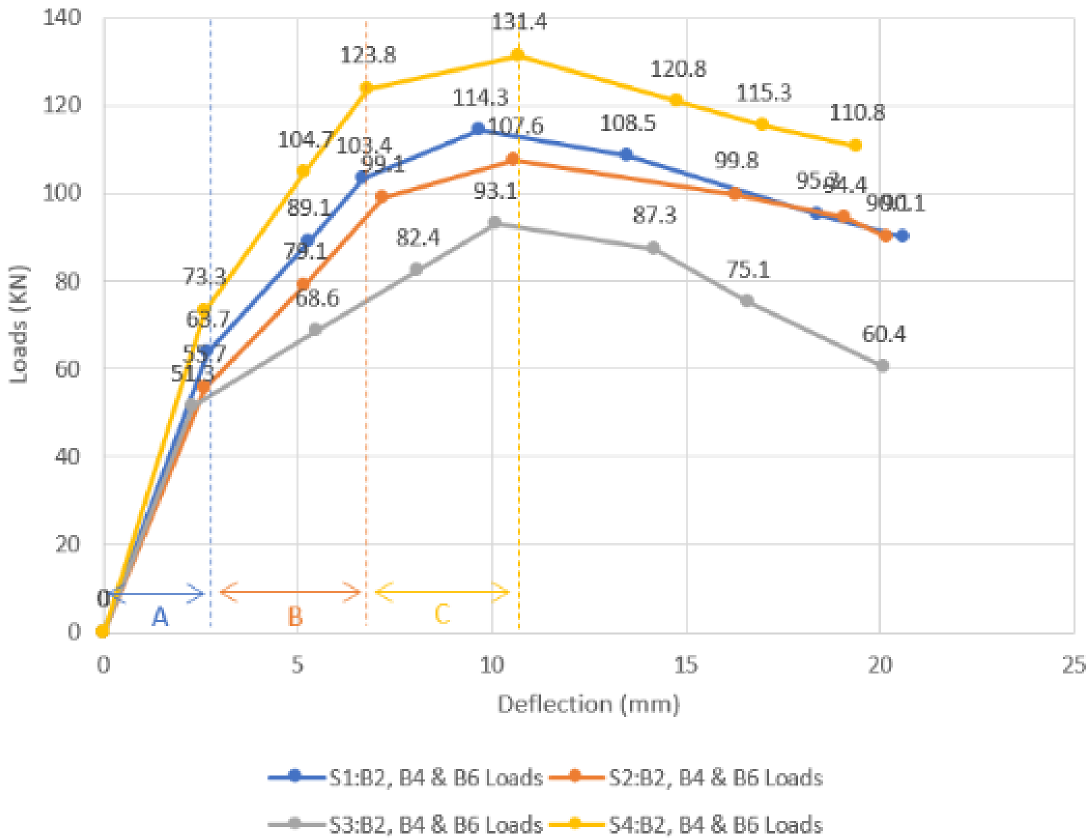


Graph-1: load-deflection curve for reinforced concrete beams of 12mm dia bars

Comparing results achieved above, the calculated design value of ultimate load is 111.8 KN it has been observed that all the result values of ultimate loads are greater than the design loads with consideration of safety factors except S3 members which has close value to design load as shown in fig 6.1.

Table-3: Load-deflection results for reinforced concrete beam of 10mm dia bars.

Sample 1: Beam 2, 4 & 6		**Sample 2: Beam 2, 4 & 6**		**Sample 3: Beam 2, 4 & 6**		**Sample 4: Beam 2, 4 & 6**		
Deflection (mm)	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**	**Load (KN)**	**Failure status**
0	0	0	0	0	0	0	0	
2.7	63.7	2.6	55.7	2.3	51.3	2.6	73.3	Load at 1st crack (Pcr)
5.3	89.1	5.2	79.1	5.5	68.6	5.2	104.7	load at 2nd crack
6.7	103.4	7.2	99.1	8.1	82.4	6.8	123.8	Yield load (Py)
9.7	114.3	10.6	107.6	10.1	**93.1**	10.7	131.4	Ultimate load (Pu)
13.5	108.5	16.3	99.8	14.2	87.3	14.8	120.8	Descending load 1st
18.4	95.3	19.1	94.4	16.6	75.1	17	115.3	2nd
20.6	90.1	20.2	90.1	20.1	60.4	19.4	110.8	3rd



Graph-2: Load - deflection curve for reinforced concrete beam for 10mm dia bars.

in general, the test result values are greater than the design loads it is observed that:

In area of (D) before cracking state, members are in state of elastic nature where the loads are proportional to deflection in this area steel and concrete has the strength to bear the applied loads.

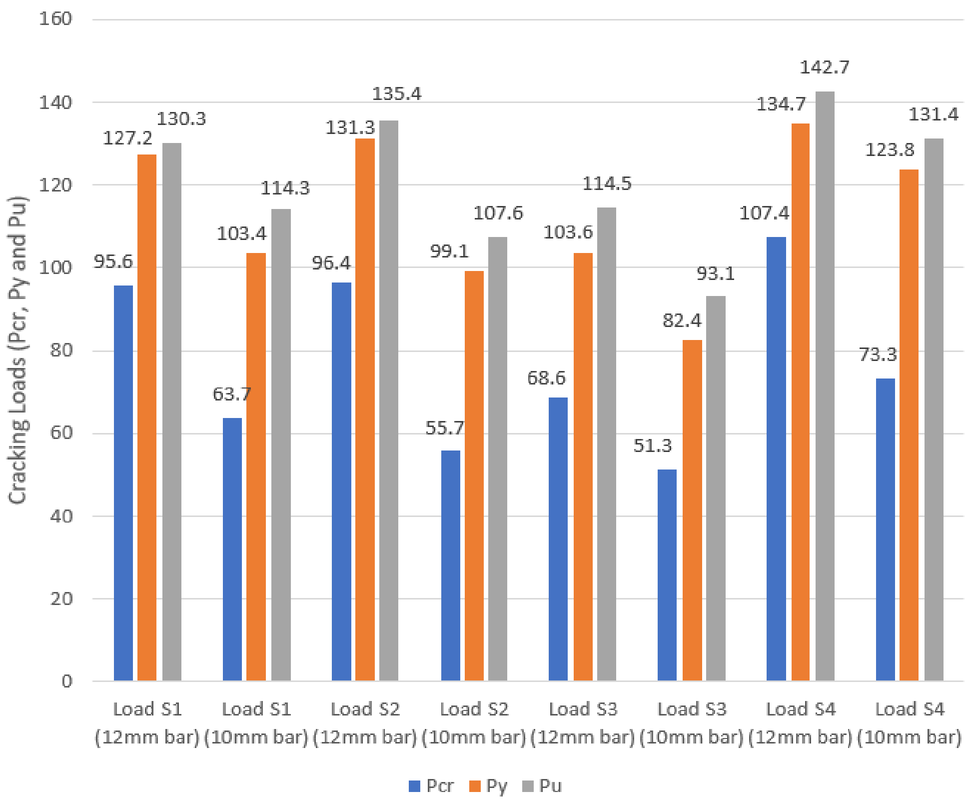
In area of (E), when the 1st crack occurs, the members turn to semi- elastic in such condition the proportionality doesn't exit the deflection increases at load increments in comparison

to the state of pre-cracking.at this moment the reinforcement starts yielding with load PY and the strength of concrete starts to decrease to with stand load which acts on the reinforcement.

In area of (F), in this condition or state the members undergo plastic behavior, the rate of cracking increases leads to the failure in this state the neutral axis changes its position to the compressive edge of the section till the full concrete failure appears in the zone ultimately the member(beam) fails.

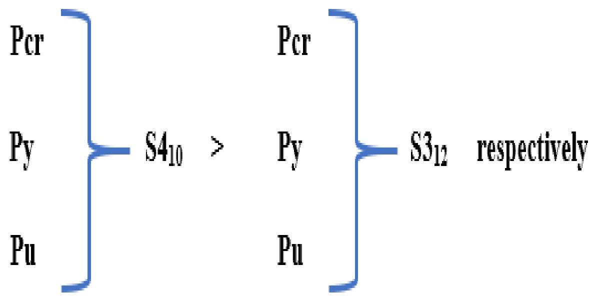
Table-4: Progressive cracks and loads applied on different reinforced concrete beams.

Loads on	Sample 1	Sample 1	Sample 2	Sample 2	Sample 3	Sample 3	Sample 4	Sample 4
Size of bars	12 mm	10 mm	12 mm	10 mm	12 mm	10 mm	12 mm	10 mm
Pcr	95.6	63.7	96.4	55.7	68.6	51.3	107.4	73.3
2nd crack	110.3	89.01	112.1	79.1	87.1	68.6	115.1	104.7
Py	127.2	103.4	131.3	99.1	103.6	82.4	134.7	123.8
Pu	130.3	114.3	135.4	107.6	114.5	93.1	142.7	131.4



Graph-3: Cracking loads (Pcr, Py and Pu)

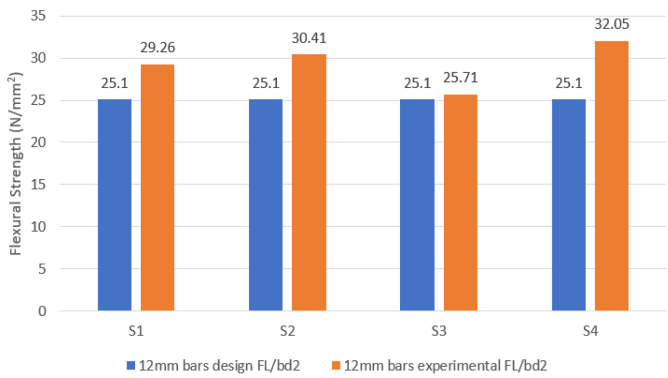
Comparison of Loads acting on members with their consequent failure effect of cracking.



B. Comparison of Results

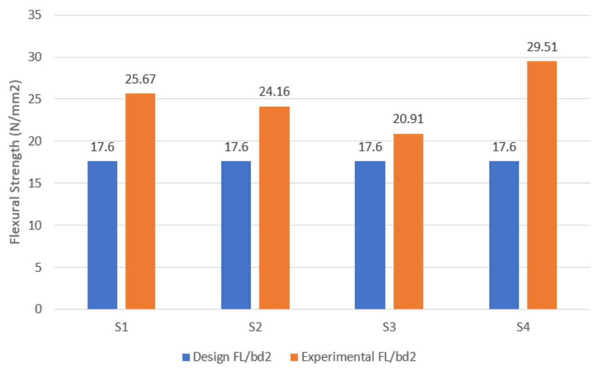
Flexural strength results of Reinforced concrete beams

1. X 12 beams



Graph-4: Flexural values of design strength Vs Experimental values of flexural strength X 12mm dia beams

2. X 10 beams



Graph-5: Flexural values of design strength Vs Experimental values of flexural strength X 10mm dia beams

Comparing results achieved above, the calculated design value of flexural strength to the experimental values, it has been observed that all the experimental values of flexural strength are greater than the design flexural strength with consideration of safety factors except S3 members which has close value to design flexural strength.

From the previous experimental studies, it has been observed that the range of ultimate loads were in the same range of 75KN to 125 KN

S1-Y10 Beam (σ) = S3-Y12 Beam (σ)

And

S2-Y10 Beam (σ)
S2-Y10 Beam (σ) } > **S3-Y12 Beam (σ)**

VII. CONCLUSION AND FUTURE SCOPE

This research is concerned with Strengthen steel in bending behavior until failure. When the capacity design for the reinforced concrete buildings or structure is sufficient, and real capacity does not surpass the actual design capabilities. In addition, RC member is a large inflexible deformation is expected to produce sufficient seismic dissipation. Because of the ability to bend. The post-productivity performance of RC members is mainly controlled by steel rods, which have some special characteristics like strength of yield, strength of tension and elasticity.

The calculated design value of ultimate load it has been observed that all the result values from experiment of ultimate loads are greater than the design loads with consideration of safety factors

Comparing results achieved above, the calculated design value of flexural strength to the experimental values, it has been observed that all the experimental values of flexural strength are greater than the design flexural strength with consideration of safety factors except S3 members which has close value to design flexural strength.

Recommendations

Further the research should be done on the strength of reinforced concrete by using 16mm 20mm 32mm reinforced bars available across the country used in many construction sites such as bridges buildings retaining wall airports roads culverts.

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AUTHORS PROFILE

Saqib Yousuf, Received His B-Tech Degree In Civil Engineering In 2016 From Punjab Technical University, Jalandhar, Pursuing M-Tech From Rimt University

Vishal Yadav, received his Btech degree in civil engineering from Kurukshetra university in 2010. MTech in structure engineering from Kurukshetra University in 2014. Working as assistant professor in department of Civil engineering RIMT university, Punjab India.

DR SANDEEP SINGLA, received his BTech degree in civil engineering in 2001 from Punjab Technical University, Jalandhar MTech from Thapar Institute of Engineering & Technology, Patiala in 2004 & PhD degree from National Institute of Technology (NIT) Kurukshetra in 2018. Presently, he is working as Professor & Head in Department of Civil Engineering, RIMT University, India. He has published more than 60 papers in national and international journals/conferences. He has guided more than 30 MTech thesis. Besides being member of board of studies in various universities, he is a life member of ISTE and also member of IEI. His research interests include environmental engineering, waste management, concrete technology, artificial intelligence, remote sensing and GIS.