International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Strengthening of New Building

Ashish L. Ganjude[1], Dr. Prashant Y. Pawade[2], Dr. Dilip P. Mase[3]

[1]M. Tech. Student, Department of Civil Engineering, G. H. Raisoni College of Engineering, Nagpur, India
[2]Head, Department of Civil Engineering, G. H. Raisoni College of Engineering, Nagpur, India
[3]Chartered Engineer, Nagpur, India

Abstract - *Modern design and construction concept, to fulfilling ever growing population and consequent demand for housing with enhanced speed of construction. With modern architectural planning & R.C.C. design techniques the quality and speed for demanded speedy construction going up every day, the quality of construction is compromised to the large extent, where adequate technique and supervision during the construction was deficient. This resulted material, quality deficiencies of structure being constructed at many places. To repair & retrofit, it is necessary to avail necessary and appropriate strengthening to the existing structure for save the human life & Structural Life. In this present paper we adopted Non Destructive Test for assessment of new residential building and after assessment work to do recommending strengthening and retesting after strengthening to the existing structure. the Existing site is situated at Aurangabad (Maharashtra). When we have done Non Destructive Test on existing structure before strengthening & after Strengthening, it is observed that the structure still not achieved the required strength which is expected so it required to do RCC Jacketing to the few columns which are found weak.*

Key Words: Assessment, Non Destructive Testing, Concrete, Grouting, Strengthening

1. INTRODUCTION

Until the end of the 19th Century, "Load Bearing" structure were constructed for housing, which had limitations on the height of the building. The main guiding principle behind the design and construction of these structures were use of locally available materials and skills.

Later in 20th century, the whole concept of design has changed from "Load Bearing Structure" to "R.C.C. Framed Structure" along with modern design and construction concept, to fulfilling ever growing population and consequent demand for housing with enhanced speed of construction. With modern architectural planning & R.C.C. design techniques the quality and speed for demanded speedy construction going up every day, the quality of construction is compromised to the large extent, where adequate technique and supervision during the construction was deficient. This resulted material, quality deficiencies of structure being constructed at many places.

Now, to examine the overall condition and performance checkups of the existing structure is nothing but the Condition Assessment. It is an appropriate tool for knowing the real health and status of the building. During the assessment we observed and investigate all the critical areas and suggested the recommended strengthening schemes etc. complete.

Non-destructive test methods are techniques that are usually used to obtained internal defects, cracks in existing structural members without damaging the object. it is quality assurance management tool, which might offers us an impressive results. NDT needs an understanding of various methods accessible on their capabilities and limitations, data of the relevant standard and specification for performing the test. This NDT techniques is to be used for observation the integrity of the structural members throughout its design life.

The main objective of present work is to adopted Non Destructive Test for assessment of new residential building and after assessment work to do recommending strengthening and retesting after strengthening to the existing structure. the Existing site is situated at Aurangabad (Maharashtra).

2. RECOMMENDED STRENGTHENING SCHEME

As per Ultrasonic Pulse Velocity Test, Rebound Hammer Test results including Visual Inspection on existing structure, it is recommended to do grouting for all the columns with Micro Fine Cement & Epoxy Resin (Non Shrink free flow low viscosity solvent free epoxy grouting required or high molecular thermo set polymer grouting) as per methodology and specification given as follows:

2.1 Micro Fine Cement Grout

Providing and injecting Micro Fine Cement Grout in the ratio by grouting pump at a pressure @ 3-7 Kg/Cm2 or as instructed by Engineer-in-charge etc. complete by considering 200mm x 200mm c/c grid along honeycombing areas and 150mm x 150mm c/c grid along cracks.

2.2 Epoxy Resin Grout to Column

Providing and injecting low viscosity solvent free epoxy in the ratio by grouting pump at a pressure @ 3-6 Kg/Cm2 or as instructed by Engineer-in-charge etc. complete by considering 200mm x 200mm c/c grid along honeycombing areas and 150mm x 150mm c/c grid along cracks.

2.3 Micro Concrete

Providing and applying 50/100/150mm micro concrete as per specification or as instructed by Engineer-in-charge etc. complete.

3. METHODOLOGY

3.1 Epoxy Resin Grout

Epoxy Resin Grout is a non-shrink, free flow, solvent free grout used for injecting into cracks, honeycombs and cavities in concrete structures. It's generally designed for injecting into narrow gaps, cracks and voids ranging from 0.25mm to 9mm.This epoxy Grout methodology is used for strengthening of concrete core, treatment to cracks in RCC and as a sealer for concrete surface. It can be used crack filling in RCC Structure, foundation, power plants and even heavy RCC structure. We have Consider 200mm x 200mm c/c grid on honeycomb areas and 150mm x 150mm c/c on cracks.

Fig -1: Epoxy Grouting on Column

3.2 Micro Fine Cement Grout

Micro Fine Cement is high strength, single part, cementitious pre packed crack injection, micro-fine cement grout powder. It's based on unique PSD (Particle Size Distribution) technology to facilitate effective filling of deep fine cracks and voids. It's particle size much finer than alternative materials like OPC. It's produced in state of the art manufacturing plant in a controlled atmosphere leading to consistent quality.

It is applicable in Crack and joint repairs by injection grouting for RCC structures like storage silo, foundation blocks, rafts, STP tanks, potable water tanks, water bearing structures, roof, bridges, basements, retaining walls, tunnel lining, etc. It is also used in Joints in masonry structures, restoration of heritage structures, dams, Soil stabilization, permeation grouting, curtain grouting, tunnel grouting, etc.

Fig -2: Micro Fine Cement Grouting on Column

3.2 Micro Concrete

Micro Concrete is a dual shrinkage compensated, thixotropic high strength formulation for structural concrete repairs. it is appropriate for putting in thicknesses of 12mm to 50 mm both vertically and overhead. It provides a durable, strong structural repair totally compatible with host concrete.

Micro Concrete is that the ideal material for vertical or horizontal structural repairs wherever the thickness of repair is over 10-12 mm and use of hand or machine applied structural repair systems is needed. This material usually used in intensive repairs to beams, columns and other structural elements also Repair of structural members subjected to repetitive loading etc.

3.3 Polymer

SBR (Styrene Butadiene Rubber) is a liquid, water-based high solids styrene butadiene polymer latex with high bonding and water proofing characteristics. it's stable under wet alkaline conditions forming a reinforcing polymer matrix within cementitious mixes.

This polymer SBR is usually used for Increase bonding of mix, Surface waterproofing, lift shafts, Waterproof Screeds, Basement Tanking whereas applying new concrete on old concrete /plasters etc.

3.4 Rebound Hammer Test

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring controlled mass rebounds and therefore the extent of such rebound

depends upon the surface hardness of concrete. The surface hardness and thus the rebound is taken to be associated with the compressive strength of the concrete. The rebound is read off along a graduated scale and is designated because the rebound number or rebound index.

The main objective of rebound hammer test are Calculating the compressive strength of concrete, Evaluating the consistency of concrete, Evaluating the quality of the concrete.

Some factors shall be kept in mind for interpretation of test results and assessing the quality of concrete such as Type of Cement, Type of Aggregate, surface condition and moisture content of concrete , curing and age of concrete, carbonation of concrete surface etc.

Fig -3: Rebound Hammer Proceq N-34

Fig -4: Rebound Hammer Test on Column

3.4 Ultrasonic Pulse Velocity Test

When the pulse is induced into the concrete from a transducer, it undergoes multiple reflections at the boundaries of the various material phases inside the concrete. A complex system of stress waves is developed which includes longitudinal (compression) Shear (transverse) and surface (Raleigh) waves. The receiving transducer defects the onset of the longitudinal waves, which is the quickest.

The main objective of Ultrasonic Pulse Velocity Test are to know the homogeneity of concrete, finding the presence of cracks, voids and other deficiencies, finding Variations in the structure of the concretes which may occur with time, evaluating the quality of the concrete.

Table -1: Gradation of Concrete Quality

Sr. No.	Velocity (Km/Sec)	Concrete Quality
1	Greater than 4.5	Excellent
2	3.5 To 4.5	Good
3	3.0 To 3.5	Medium
4	Less than 3.0	Doubtful

Fig -5: Ultrasonic Testing Machine Canopus CUTE 103

Fig -6: Ultrasonic Testing on Column

4. PROPERTIES

4.1 Epoxy Resin Grout

- Base : Epoxy
- Mix Proportion: Base : Hardener
  (By Weight) 100 : 50
- Toxicity : Non-toxic on Cure
- Pot Life : 30 Minutes at 25°C
- Viscosity of mixed adhesive : 3 to 10 cps at 25°C

4.2 Micro Concrete

- Appearance & Colour : Grey Powder
- Water Powder ratio : 0.16

- Compressive Strength : 15 MPa 1 Day
  25 MPa 3 Days
  35 MPa 7 Day
  45 MPa 28 Day
- Density : Approx. 2250 Kg/Cum
- Mixing water per 25Kg : Approx. 3.75 - 4.25 Litres
- Application Temperature
  Substrate : +5 to +40°C
  material : +5 to +30°C

4.3 Micro Fine Cement Grout

- Form : Dry Fine Powder
- Component : Single
- Particle Size : <15 micron
- Blaine Fineness: >8000 Sq.cm/gm
- Marsh Cone Viscosity: 35 to 55 seconds
- Compressive Strength : >40Mpa@ 7 days
  >50Mpa@28days

4.4 Polymer (SBR)

- Consistency : Brushable Viscous Slurry
- Bond Strength : 28.6 Mpa

5. ADVANTAGES

5.1 Micro Fine Cement Grout

i. It is a single component so just add water for hassle free grouting
ii. It has Effective penetration in and filling of deep fine cracks, fissures & pore spaces. Imparts greater water tightness.
iii. It is high Strength Material.
iv. It is compatible with structural concrete.

5.2 Micro Fine Cement Grout

i. Due to Low viscous property it are often injected or poured into fine cavities and narrow gaps easily. It has high mechanical strength due to that it perform well even under heavy loads and stress.
ii. It has good bonding with old surface due to their excellent adhesive strength.
iii. This grouting has two components i.e. Epoxy and Hardener, so it is very easy to mix and handle.
iv. It completely fills the voids and cracks due to non shrink.
v. It can be used in aggressive environment only because of chemical resistant.

5.3 Micro Concrete

i. It has volume stable in wet and hardened state reducing cracking tendency due to dual Shrinkage compensated.
ii. It gives uniform predictable performance even in remote situations.
iii. It doesn't required bonding agent.
iv. It has long life repair due to impermeable to aggressive elements.
v. It is spray able due to that it is able to repair complex profiles easily with minimal rebound.

5.4 Polymer (SBR)

i. It can improves the adhesion / bonding of cementitious mixes.
ii. It is an effective plasticizer, giving accumulated workability and cohesion.
iii. It permits reductions in water content to enhance durability and strength without loss of workability.
iv. it is also an excellent waterproofing admixture, which is alkali stable in cementitious mixtures.

6. RESULTS

6.1 Ultrasonic Pulse Velocity Test Results

Sr. No.	Description	No. of Points	Ultrasonic Pulse Velocity (Km/Sec)		
			Max.	Min.	Average
Basement					
1.	Before Repair	69	2.91	0.97	1.94
	After Repair	52	3.75	2.60	3.18
Ground Floor					
2.	Before Repair	43	2.75	1.80	2.28
	After Repair	56	3.21	2.50	2.86
First Floor					
3.	Before Repair	68	3.82	2.03	2.93
	After Repair	24	3.38	2.80	3.09
Second Floor					
4.	Before Repair	59	3.10	1.75	2.43
	After Repair	24	3.23	2.80	3.02
Third Floor					
5.	Before Repair	79	3.74	2.53	3.14
	After Repair	20	3.62	3.03	3.33

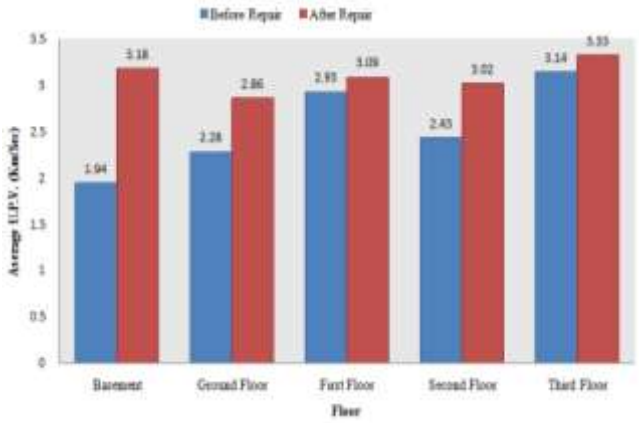

Chart -1: Comparison of Ultrasonic Pulse Velocity

Ultrasonic Pulse Velocity Test results with direct, indirect and semi direct method founds that maximum reading are between 1.94 Km/Sec to 3.14 Km/Sec (Before Repair) & 2.86 Km/Sec to 3.33 Km/Sec (After Repair) (Refer to IS 13311(Part I):1992).

6.2 Rebound Hammer Test Results

Sr. No.	Description	No. of Points	Rebound Hammer Test		
			Max.	Min.	Average
Basement					
1.	Before Repair	126	27.77	18.88	23.33
	After Repair	135	28.22	18.89	23.56
Ground Floor					
2.	Before Repair	126	23.50	15.56	19.53
	After Repair	90	25.11	18.67	21.89
First Floor					
3.	Before Repair	126	24.89	16.89	20.89
	After Repair	54	28.44	19.55	24.01
Second Floor					
4.	Before Repair	135	26.22	17.11	21.67
	After Repair	54	28.44	20.44	24.67
Third Floor					
5.	Before Repair	135	26.21	19.56	26.78
	After Repair	45	30.22	21.33	27.54

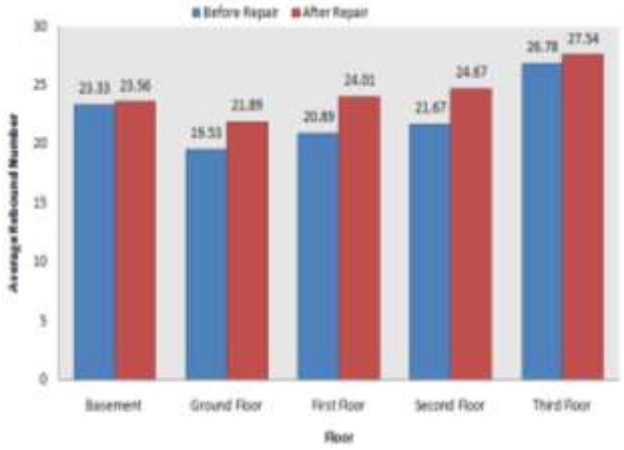

Chart -2: Comparison Rebound Hammer Test

Rebound Hammer Test maximum readings are founds that maximum reading are between 19.53 to 26.78 (Before Repair) & 21.89 to 27.54 (After Repair) (Refer to IS 13311(Part II):1992).

6. CONCLUSIONS

- As per detailed systematic methodology while conducting condition assessment of new building at Aurangabad. This includes Ultrasonic Pulse Velocity Test and Rebound Hammer Test before strengthening and after strengthening.
- It is observed that the Ultrasonic Pulse Velocity Test results with direct, indirect and semi direct method found that maximum reading are between 1.94 Km/Sec to 3.14 Km/Sec (Before Repair) & 2.86 Km/Sec to 3.33 Km/Sec (After Repair) (Refer to IS 13311(Part I):1992).
- It is also observed that in the Rebound Hammer Test maximum readings are Rebound Hammer Test maximum readings are founds that maximum reading are between 19.53 to 26.78 (Before Repair) & 21.89 to 27.54 (After Repair) (Refer to IS 13311(Part II):1992).
- When we have done Non Destructive Test on existing structure before strengthening & after Strengthening, it is observed that the structure still not achieved the required strength which is expected so it required to do RCC Jacketing to the few columns which are found weak based upon the reading.

6. FUTURE SCOPE OF WORK

- It is necessary to do Condition Assessment of every building or RCC Structure for Structural Stability Certification.

- If the building not strengthen with the help of Grouting i.e. Epoxy Resin Grout and Micro Fine Cement Grout, then it is necessary to do RCC Jacketing.
- For Strengthen the Building we also go for Steel Plate Jacketing.
- Carbon wrapping is also the essential tool for strengthening.

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