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Structural Health Monitoring of Concrete Structure by Non Distructive Evaluation

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Abstract: *Day to day we see various defects and problems in our structures like cracks ,honeycombing, settlement and displacement, deformation and so on which is directly responsible for the lifespan of structure. But we really aware of about our structure conditions? We really need to monitor the health of our structures? Anyone curious about what exactly causes of these defects? Yes! Structural health monitoring is very necessary and essential in these days. In these polluted world ,various causes are responcible for structural deteriotions.*
Structural health monitoring ensure the quality and structure life span. Structural health monitoring is nothing but monitor or investigate the change occurs in the structure which help the understand compressive strength of material. Then how to monitor structure ? Yes it is possible without distruction of building, which is using non distructive testing evaluation. in civil engineering various NDT has like rebar hammer, ultrasonic velocity ,carbonation test and half cell potentionmeter

Keywords: Non-Destructive Evaluation, Structural Health Monitoring, Columns, Steel, Composite Sections of concrete & compressive Strength, stress-strain relations, strength determination, Concrete damage detection

I. INTRODUCTION

Day to day we see various defects and problems in our structures like cracks ,honeycombing, settlement and displacement, deformation and so on which is directly responsible for the lifespan of structure. But we really aware of about our structure conditions? We really need to monitor the health of our structures? Anyone curious about what exactly causes of these defects? Yes! Structural health monitoring is very necessary and essential in these days. In these polluted world ,various causes are responsible for structural deteriotions.
Structural health monitoring ensure the quality and structure life span. Structural health monitoring is nothing but monitor or investigate the change occurs inthe structure which help the understand compressive strength of material. Then how to monitor structure ? Yes it is possible without distruction of building, which is using non distructive testing evaluation in civil engineering various NDT has like rebar hammer, ultrasonic velocity ,carbonation test and half cell potentionmeter.
These tests are help indirectly to find out compressive strengths of structure. Buttests does not gives actual compressive strength. It gives you probable value that why it accuracy it`s like plue minus 10 or 25 %.it is because we had concrete as material, which is heterogenous in properties that why lot of limitations are contain in NDT. and NDT accuracy are actually depend on how to take ND testing, what precausions, guideline you follows.

II. LITERATURE REVIEW

Literature survey is carried out by study of various Research paper related on Structural health monitoring and condition assessment of RC structure
D. Breysse –Non distructive evaluation of concrete strength: an historical review and a new perpective by combining NDT methods‖-19th Dec 2011, in this paper has been analyzes why and how non destructive testing (NDT) measurements can be used in order to assess on site strength of concrete. It is based on a) an in-depth critical review of existing models, (b) an analysis of experimental data gathered by many authors in laboratory studies as well as on site,

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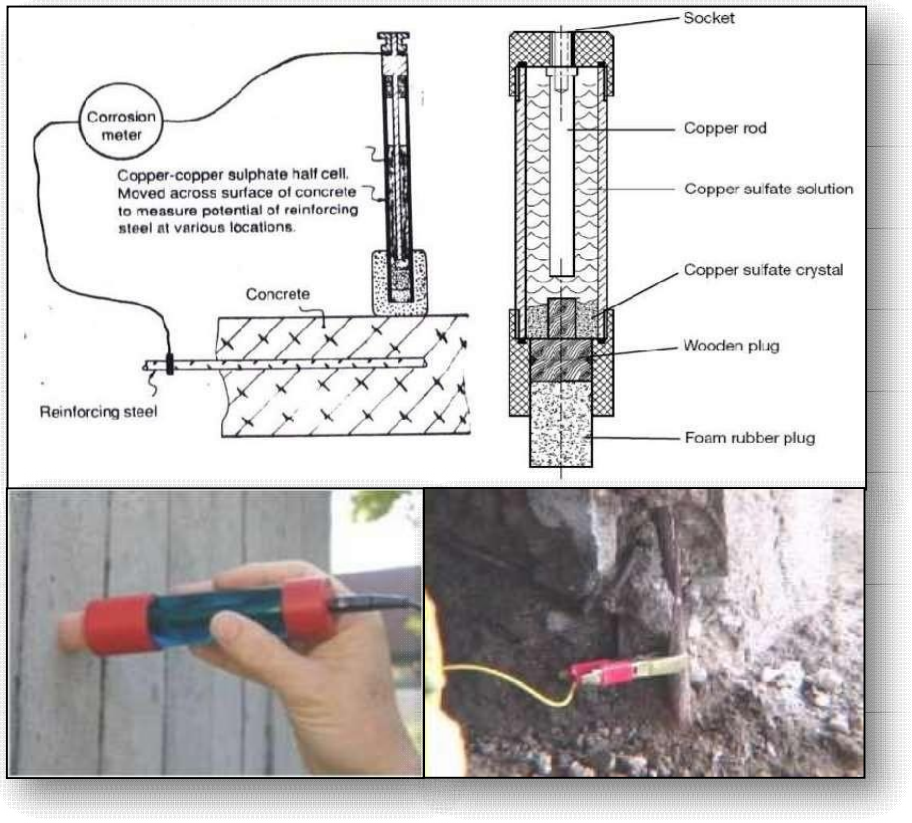
(c) the development and analysis of synthetic simulations designed in order to reproduce the main patterns exhibited with real data while better controlling influencing parameters. The key factors influencing the quality of strength estimate are identified. Two NDT techniques (UPV and rebound) are prioritized and many empirical strength-NDT models are analyzed. It is shown that the measurementerror has a much larger influence on the quality of estimate than the model error. The key issue of calibration is addressed and a proposal is made in the case of the SonReb combined approach.

III. WORKING PRINCIPLE

The instrument measures the potential and the electrical resistance between the reinforcement and the surface to evaluate the corrosion activity as well as the actual condition of the cover layer during testing. The electrical activity of the steel reinforcement and the concrete leads them to be considered as one half of weak battery cell with the steel acting as one electrode and the concrete as the electrolyte. The name half-cell surveying derives from the fact that the one half of the battery cell is considered to be the steel reinforcing bar and the surrounding concrete. The electrical potential of a point on the surface of steel reinforcing bar can be measured comparing its potential with that of copper sulphate reference electrode on the surface.

Practically this achieved by connecting a wire from one terminal of a voltmeter to the reinforcement and another wire to the copper sulphate reference electrode



IV. CALCULATIONS

Colour observation

a) Instantaneous Red purple colour occur within 30 sec

B) Slow development of colour

C) Boundary is diffuse

Creep back towards surface that occurred after the original result wasrecorded within 30 sec of spraying.

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V. RESULT AND DISCUSSION

After co-relating with core strength, Core UPV & Rebound values and strength calibration charts prepared by CDC PL lab, the strength of site members may be assumed as mentioned above in results.

During removal of plaster at these test locations it was observed that the surface layer concrete has Spalled along with plaster; indicating probable weak concrete on surface.

Before testing all such points were treated with fast setting cement; so as to give flat & smooth surface for UPV testing.

During this evaluation and assessment process we observed that rebound hammer is like just stethoscope because doesnot gives the direct compressive strength of structures.it is indirect method for measuring the hardness of concrete which indirectly related to probable value of compressive strength.

During the determining the compressive strength rebound hammer value take only 20% as compared to ultrasonic plus velocity.

Rebound hammer testing is only reliable to 25mm to 45mm depth of concrete.and it alsodepend upon various factors.

In ultrasonic plus velocity is near to compressive strength of concrete,it is 80% responsible for concrete strength.

It also depends upon various factors and in this test density of concrete is not directly affect the velocity.it just myth or assumption.

When variation in properties of concrete affect the test results the use of one method alone would not be sufficient to study and evaluate the required property. Therefore, the use of more than one method yields more reliable results.

REFERENCES

[1]. BS1881:Part 201:1986 - Guide to the use of non destructive methods of test for hardened concrete
[2]. BS1881:Part 203:1986 - Recommendations for measurement of velocity of ultrasonic pulses in concrete
[3]. BS1881:Part 207:1992 - Recommendations for the assessment of concrete strength by near-to-surface tests
[4]. IS 13311 : Part 1 :1992 – NDT of Concrete – Method of test - UPV
[5]. IS 13311 : Part 2 :1992 – NDT of Concrete – Method of test – Rebound Hammer
[6]. IS – 456 – 2000 – Plain & RCC – Code of Practice
[7]. IS – 1199 – 1959 - Method of sampling & Analysis of Concrete
[8]. IS – 516 – 1959 – Methods of tests for Strength of Concrete
[9]. ACI – SP 82 – In Situ / Non Destructive Testing of Concrete
[10]. ACI 311.4 4R-00 – Guide for Concrete Inspection
[11]. ACI 365.1 R-00 – Service life Prediction – State of Art ReportACI 214.4 R-03 – Guide for obtaining Cores & Interpreting Compressive strength results.
[12]. ACI 228.2 R-98 – NDT Methods for Evaluation of Concrete in Structures
[13]. ACI 228.1 R-03 – In-Place Methods to Estimate Concrete Strength
[14]. ACI 437 R-03 – Strength Evaluation of Existing concrete buildings
[15]. ACI – SP - 168 – Innovations in NDT of concrete
[16]. ACI – SP – 112 - NDT
[17]. ACI – Monogram No – 9 – Testing of Hardened concrete – NDT methods
[18]. ACI –Monogram Series – Evaluation of Concrete Properties from Sonic Tests
[19]. Malhotra V. M. (Ed.) - Testing Hardened Concrete: Non-destructive Methods, ACI, monograph No. 9, Detroit, US, 1976.
[20]. Malhotra V. M. – Handbook of NDT of concrete – Second Edition
[21]. J. H. Bungey - The Testing of Concrete in Structures
[22]. N. J. Carino – NDE to Investigate Corrosion status in Concrete Structures
[23]. P.A.M. Basheer – Near Surface Testing for strength & Durability of Concrete
[24]. R. Halmshaw – NDT – Second Edition
[25]. H. W. Reinhardt – Testing during Concrete Construction
[26]. Periodical Structural Inspection of Existing Buildings – Building & Construction Authority Singapore
[27]. Guidelines for Structural Audit , Assessment . Evaluation and Strengthening of Existing buildings Structures - Indian Association of Structural Engineers

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[28]. D. Breysse ―Nondestructive evaluation of concrete strength: An historical review and a new perspective by combining NDT methods‖ , Elsevier – 19th December 2011.
[29]. Ha-Won Song and VeluSaraswathy, ―Corrosion Monitoring of Reinforced Concrete Structures – A Review‖ , International journal of Electrochemical of science , 1st Jun
[30]. KatalinSzilágyi ,AdorjánBorosnyói, IstvánZsigovics ―Rebound surface hardness of concrete.
[31]. A. V. Malhotra, Editor, Testing Hardened Concrete: Non-destructive Methods, ACI, Detroit, US(1976) monograph No. 9.
[32]. A. Leshchinsky, Non-destructive methods Instead of specimens and cores, quality control of concrete structures. In: L. Taerwe and H. Lambotte, Editors, Proceedings of the International Symposium held by RILEM, Belgium, E&FN SPON, UK (1991), pp. 377– 386.
[33]. ASTM C 805-85, Test for Rebound Number of Hardened Concrete, ASTM, USA (1993).
[34]. BS 1881: Part 202, 1986: Recommendations for Surface Hardness Tests by the Rebound Hammer, BSI, UK (1986).
[35]. In Place Methods for Determination of Strength of Concrete; ACI Manual of Concrete Practice, Part 2: Construction Practices and Inspection Pavements, ACI 228.1R-989, Detroit,MI (1994) 25 pp..
[36]. T. Akashi and S. Amasaki, Study of the stress waves in the plunger of a rebound hammer at the time of impact. In: V.M. Malhotra, Editor, In situ/Nondestructive Testing ofConcrete, ACISP-82, Detroit (1984), pp. 19–34.
[37]. S. Amasaki, Estimation of strength of concrete structures by the rebound hammer. CAJ ProcCem Conc 45 (1991), pp. 345–351.
[38]. W. Grieb. In: Use of the Swiss Hammer for Estimating the Compressive Strength of HardenedConcrete, FHWA Public Roads 30 (1958), pp. 45–50 Washington, DC, No. 2, June.
[39]. C. Willetts. Investigation of Schmidt Concrete Test Hammer, Miscellaneous Paper No. 6-267,
[40]. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS (1958) June.
[41]. A. Neville and J. Brooks. Concrete Technology, Longman, UK (1994).
[42]. G. Teodoru, The use of simultaneous nondestructive tests to predict the compressive strength of concrete. In: H.S. Lew, Editor, Nondestructive Testing vol. 1, ACI, Detroit (1988), pp. 137– 148 ACI SP-112.
[43]. A. Neville. Properties of Concrete, Addison-Wesley Longman, UK (1995).
[44]. ASTM C 597-83 (Reapproved 1991), Test for Pulse Velocity Through Concrete, ASTM, USA(1991).
[45]. BS 1881: Part 203: 1986: Measurement of Velocity of Ultrasonic Pulses in Concrete, BSI, UK (1986).
[46]. A. Nilsen and P. Aitcin, Static modulus of elasticity of high strength concrete from pulse velocity tests. Cem Concr Aggregates 14 1 (1992), pp. 64–66.
[47]. R. Philleo, Comparison of results of three methods for determining Young's modulus of elasticity of concrete. J Am Concr Inst 51 (1955), pp. 461–469 January.
[48]. M. Sharma and B. Gupta, Sonic modulus as related to strength and static modulus of high strength concrete. Indian Concr J 34 4 (1960), pp. 139–141.
[49]. ACI 318-95, Building Code Requirements for Structural Concrete (ACI 318-95) and Commentary-ACI 318R-95, ACI, USA (1995) 369 pp..
[50]. E. Whitehurst, Soniscope tests concrete structures. J Am Concr Inst 47 (1951), pp. 433–444 Feb..
[51]. R. Jones and E. Gatfield. Testing Concrete by an Ultrasonic Pulse Technique, DSIR RoadResearch Tech. Paper No. 34, HMSO, London (1955).