

‘A Case Study’ On Repair Rehabilitation & Retrofitting of RC Framed Structure

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ABSTRACT: The building material mainly reinforced concrete is being used comprehensively for innumerable forms of construction developments. However, the deterioration of Reinforced Concrete structures is acknowledged as a foremost problem. To one side, it requires regular maintenance and on other side many structures call for widespread repair, rehabilitation & retrofitting. With the passage of time, as these structures develop older, we discover in them certain dilapidation or weakening with subsequent distress revealed in the form of delamination, cracking, corrosion and splitting etc. Such worsened structures can be repaired, rehabilitated and retrofitted by means of several sorts of admixtures & new repair materials. The purpose of this paper is to suggest methods of repair, rehabilitation and retrofitting of RC framed structures with the help of a case study where the author was involved at every stage. In the case study of the structure involved the focus was made on the determination and correlation of the results of various non-destructive tests for the purpose of suggesting suitable sustainable measures for the rehabilitation of the structures.

KEYWORDS: Repair, Rehabilitation, Retrofitting, Non-Destructive Testing

I. INTRODUCTION

Concrete construction is anticipated to bounce distress free service through its proposed design life. Nonetheless, these anticipations are not apprehended in countless erections because of structural insufficiency, material deterioration, unforeseen over loadings or physical destruction. Untimely material weakening can ascend from a number of causes, the paramount being when the construction specifications are sullied or the facility is bare to severer service environment than those likely during the planning and designing stages. Physical damage can also ascend after fire, explosions as well as after restraints, both internal and external, against structural movement. Concrete is the most extensively used and adaptable construction material owning numerous leads over steel and other construction materials. Yet, very often one emanates across with certain defects in concrete. The defects may evident themselves in the form of spalling of concrete, cracks, excessive deflections, exposure of reinforcement and/or other signs of distress. On many instances, corrosion of reinforcement can prompt off cracking and spalling of concrete, together with deterioration in the strength of the construction. Such circumstances demand for repairs of exaggerated zones and occasionally for the replacement of the whole structure. The necessity to increase the capacity of an enduring building to fight from weathering action, embedded metals, chemical attack, alkali-aggregate reactivity, due to overload, fire, seismic forces, etc. rises typically from the indication of damage and deprived behaviour. These sort of structures are deteriorated with usage and time and might have conceded their design life and necessitate repair and rehabilitation. Consequently the answers for RCC structure or structural elements are vital and for this miscellaneous techniques are exploited. Strength calculation of a prevailing structure or one element of structures is necessary to shelter all the standards in which maintenance is essential. Therefore, non-destructive, partially destructive and destructive techniques in the surviving structures are used for assessment of concrete structure and to estimate the cause of deterioration of the concrete. Some explanations of deteriorations due to ageing and error in design and detailing can also be investigated.

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The work in this paper is focused on the non-destructive testing for the repair, rehabilitation and retrofitting of an existing RCC structure. The building considered for the case study was built 15 years back and was not in use since then. Now it has to be refurbished to make it fit for the future use.

II. RELATED WORK

NON DESTRUCTIVE TESTING

Non-destructive testing can be applied to both old and new structures. For new structures, the principal applications are likely to be for quality control or the resolution of doubts about the quality of materials or construction. The testing of existing structures is usually related to an assessment of structural integrity or adequacy. In either case, if destructive testing alone is used, for instance, by removing cores for compression testing, the cost of coring and testing may only allow a relatively small number of tests to be carried out on a large structure which may be misleading. Non-destructive testing can be used in those situations as a preliminary to subsequent coring.

A. SCHMIDT REBOUND HAMMER TEST

PRINCIPLE OF TEST: (IS-13311 (P-2))

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. Therefore, the rebound is taken to be the compressive strength of the concrete. The rebound is read off along a graduated scale and is designated as the 'Rebound Number' or 'Rebound Index'.

INTERPRETATION OF RESULTS

Results will not be the same in case of internal micro-cracking or heterogeneity across the cross section. The probable accuracy of concrete strength in a structure is $\pm 25\%$. The accuracy of results and confidence are greatly increased if the relationship between rebound index and compressive strength is obtained from the structure and standard specimen like concrete cubes.

Sr. No	Average Rebound Number	Quality of Concrete
1	Above 40	Very good hard layer
2	30 to 40	Good layer
3	20 to 30	Fair layer
4	Below 20	Poor layer
5	0	Delaminated

B. ULTRASONIC PULSE VELOCITY TEST

In ultrasonic testing, an ultrasound transducer connected to a diagnostic machine is passed over the object being inspected. The transducer is typically separated from the test object by a couplant (such as oil) or by water, as in immersion testing. However, when ultrasonic testing is conducted with an Electromagnetic Acoustic Transducer (EMAT) the use of couplant is not required.

There are two methods of receiving the ultrasound waveform: reflection and attenuation. In reflection (or pulse-echo) mode, the transducer performs both the sending and the receiving of the pulsed waves as the "sound" is reflected back to the device. Reflected ultrasound comes from an interface, such as the back wall of the object or from an imperfection within the object. The diagnostic machine displays these results in the form of a signal with amplitude representing the intensity of the reflection and the distance, representing the arrival time of the reflection. In attenuation (or through-

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transmission) mode, a transmitter sends ultrasound through one surface, and a separate receiver detects the amount that has reached it on another surface after traveling through the medium. Imperfections or other conditions in the space between the transmitter and receiver reduce the amount of sound transmitted, thus revealing their presence.

Using the couplant increases the efficiency of the process by reducing the losses in the ultrasonic wave energy due to separation between the surfaces. The Homogeneity of the concrete, the presence of cracks, voids and other imperfections, changes in the structure of the concrete which may occur with time, the quality of the concrete in relation to standard requirement, the quality of one element of concrete in relation to another and concrete quality can be assessed by UPV test.

Sr. No	Avg. Velocity	Concrete Quality
1	Above 4.5 km/sec	Excellent
2	3.5 – 4.5 km/sec	Good
3	3.0 – 3.5 km/sec	Average
4	Below 3.0 km/sec	Doubtful

III.REPAIR, REHABILITATION AND RETROFITTING

REPAIR

Repair denotes to the action taken on a non-compliant component of a structure so that it turn out to be capable of satisfying its scheduled function, whether or not in compliance to its original specifications.

REHABILITATION

Rehabilitation is the techniques of refurbishing the building to service level that it had and now lost.

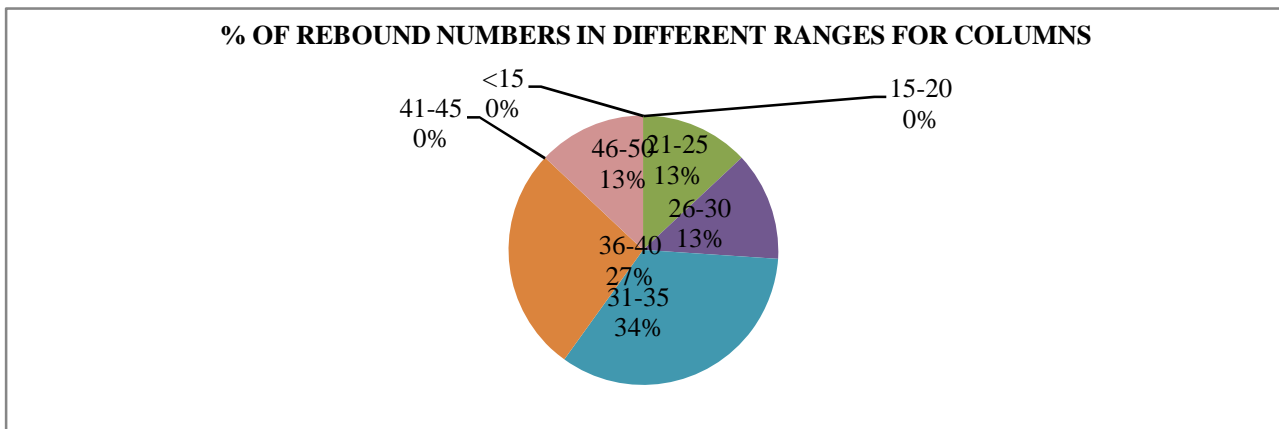
RETROFITTING

The engineering which comprises in transforming the prevailing buildings for structural performance without hindering its elementary intent of use is called as retrofitting.

IV.EXPERIMENTAL RESULTS

The Pie charts below shows the results of the rebound hammer test and the ultrasonic pulse velocity test conducted on columns, beams and slabs of the building under consideration. The tests were conducted on ground + 6 floors.

REBOUND HAMMER TEST RESULTS



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ULTRASONIC PULSE VELOCITY TEST RESULTS

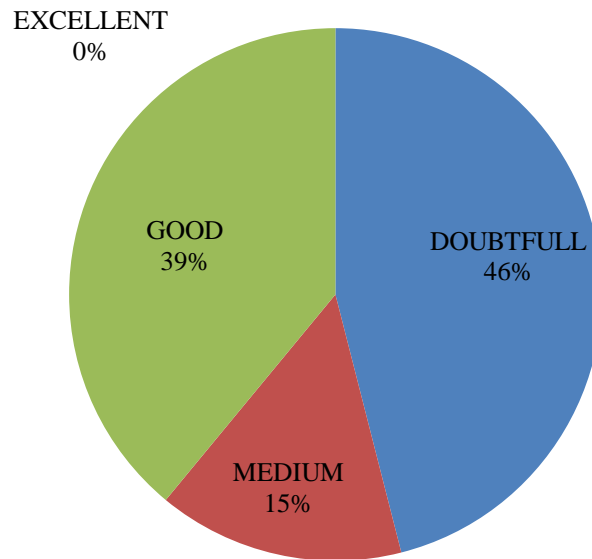
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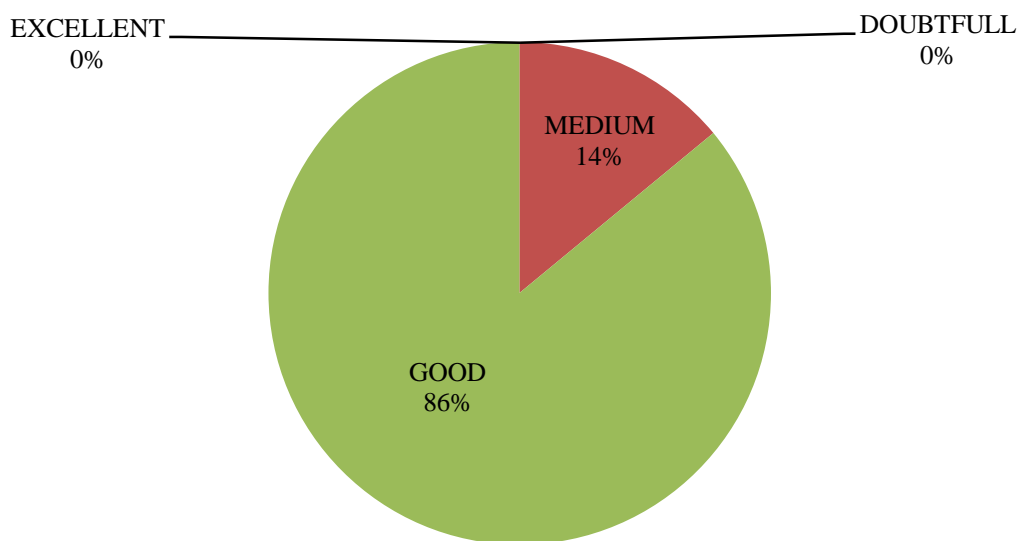
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Vol. 6, Issue 11, November 2017

QUALITY OF CONCRETE BASED ON UPV VALUE FOR COLUMNS



QUALITY OF CONCRETE BASED ON UPV VALUE FOR BEAMS

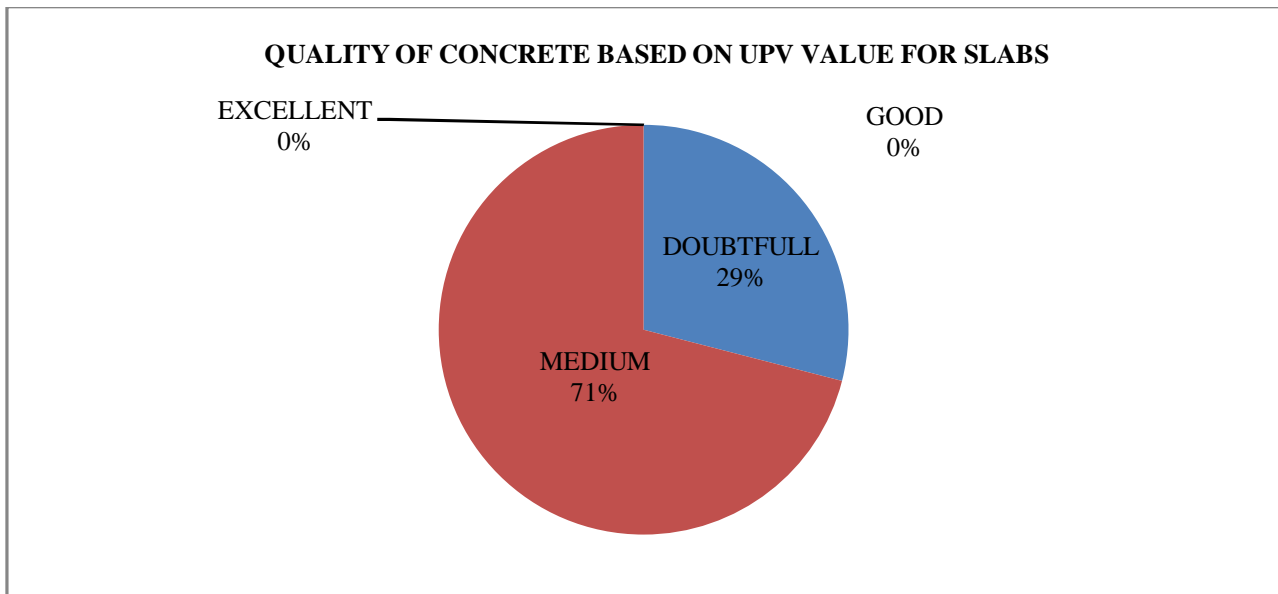


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V.CONCLUSION

On the basis of the non-destructive tests performed on the buildings, I found that the quality of concrete and the general workmanship varies from poor to good whereas the avg. compressive strength of the concrete used in columns, beams and slabs is of the range of 25 MPa to 30MPa. Based on these tests various methods such as guniting, routing and sealing, RCC jacketing etc. has been suggested for the repair, rehabilitation and retrofitting of the building.

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