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Qualitative Assessment of Concrete

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Abstract: *The statistical quality assessment of the concrete is very effective tool for evaluation of quality of concrete. The statistical evaluation solely depends on how effectively and efficiently calculates standard deviation and how many samples considered. The statistical process techniques as cumulative sum control charts are helpful for detecting causes of variation in the process of producing concrete. In general, concrete produced at site can have large variation in their properties related to strength and durability not only from batch to batch but also within a batch. The magnitude and direction of this variation depends on many factors like the quality of the ingredient materials, method of batching, proportioning, mixing, placing and the supervisory control at site.[1] Random assessment of a mix was analyzed for its quality and evaluate the variance for strength deviation.*

Keywords: *Quality assessment, variability, compressive strength, standard deviation,*

I. INTRODUCTION

Concrete is the most widely used material in construction industry. It is important to understand and find engineering approaches and ways to improve the quality of this product at production plants and construction sites as well. In any construction project, compressive strength is the most common indicative criterion to assess the acceptability of a concrete batch supplied by any given plant. Variability in compressive strength of the concrete batches from any plant is inevitable. Sources of such variability range from errors in proportion measurement of the batch ingredients to the variation in the properties of these ingredients. Statistical parameters such as standard deviation of compressive concrete strength and bias in its mean are the primary indicators in such analyses [2].

A. Variation In Strength Of Concrete

Variation in compressive strength as measured by standard deviation (σ) and can be measured as level of quality control at production. In order to improve concrete quality, strength standard deviation should be reduced and this can only be achieved through the reduction of variability in materials, manufacturing process and testing methods.

Graham and Martin (1946) were the first to publish an attempt to locate and quantify sources of variability on an actual project. The project was Heathrow Airport, UK, on which 0.5 million cubic yards of concrete were produced and controlled in an exemplary manner. They identified the variation factor and calculated the possibility of effect and concluded that cement was responsible for 48.2% of the variation of strength that occurred at Heathrow, and therefore that this was not under site engineers' control [3].

Table 1

| Variability Factor | Possibility of variation |
|---------------------------|--------------------------|
| Quantity of cement | 48.2% |
| Water cement ratio | 18.4% |
| Sampling and making cubes | 11.5% |
| Testing cubes | 13.8% |
| Mixing Time | 4.6% |
| Varying SG of aggregate | 3.5% |
| Total | 100% |

From this table if we prioritize the variability factor then quality of cement comes first almost 50% then water cement ratio around 20% and third cubes testing around 15%. Cement is a factory made product and its physical and chemical property at site cannot be controlled by engineers whereas water cement ratio and cube testing variable can be well managed at site and reduce the variation.

Rest of the variability also influence the quality but their share is less and can manage this small variability by using good materials and adopting good quality control practice at site.

The above factors causing variability as shown in Table 1 was base on one specific project but in general following list of factors are applicable in most of the cases:

- 1) Slump (mis-judgment or deliberate variation)
- 2) Temperature
- 3) Air content
- 4) Silt content in fine aggregate
- 5) Organic impurities in fine aggregate
- 6) Fine aggregate grading
- 7) Fine aggregate grain quality
- 8) Coarse aggregate dust content
- 9) Coarse aggregate bonding characteristics
- 10) Cement quality
- 11) Admixture quality, dosage or compatibility
- 12) Fly-ash quality (especially carbon content)
- 13) Time delays
- 14) Mixing time
- 15) Coarse aggregate strength
- 16) Sampling and testing procedure

Variability's are many but finding principle causes are important. These can be done in two distinct stages:

- a) Compare actual and predicted strength and if there is a discrepancy, track it down. This may provide a firm lead on what is most likely to affect strength on the particular project.
- b) Monitor strength and a selected number of 'related variables' using Cusum analysis.

The selected variables will usually include slump, air content and concrete temperature. If reasonably reliable water content is available from any source, this is certainly very important. The strength results will be particularly examined for pair differences and 7 to 28 day gain as a kind of internal consistency test. It is important to realize that low strengths do not 'just happen' they are usually caused by either high water content, low cement content, incomplete compaction, defective curing and testing, or reduced cement quality. The art or science of quality control is to establish which of these is the cause by a logical examination of the pattern of results [3].

II. DATA ANALYSIS

To study the variability of concrete cubes strength, one month field test data of cement compressive strength, test results of abrasion resistance (wearing and non-wearing) of aggregates, test results of crushed sand and concrete cube tests data has been taken.

Variation of compressive strength of cement samples over a month has been shown in the fig 1. Samples were collected from nine batching plants and 12 samples of PPC of same brand were tested during the month.

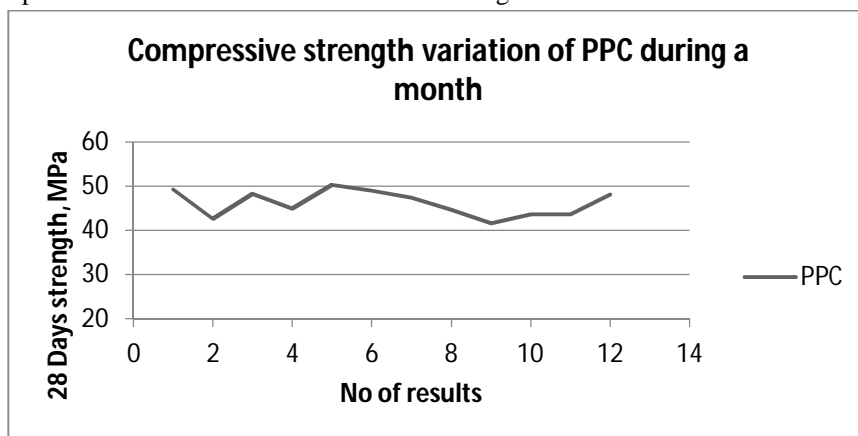


Fig 1

Coarse aggregate samples were collected from different batching plants. Source of processed aggregate was from 400 TPH aggregate processing plant. Total eighteen numbers of sample were tested during the month and variation of abrasion values for wearing coarse shown in the fig 2. From the figure it is evident that with one peak variation is within the acceptance limit as specified in IS 383-2016.

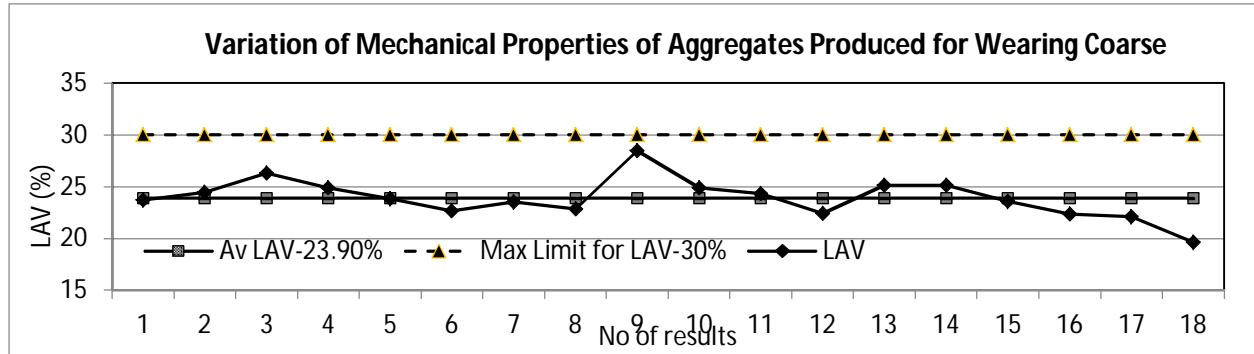


Fig 2

Non-wearing coarse aggregate samples were collected from different batching plants which was separately stacked. Total thirteen numbers of sample were tested during the month and variation of abrasion values for non-wearing coarse shown in the fig 3. From the figure it is evident that with one peak variation is within the acceptance limit as specified in IS 383-2016. In fact 50% samples were conforming the wearing coarse criteria.

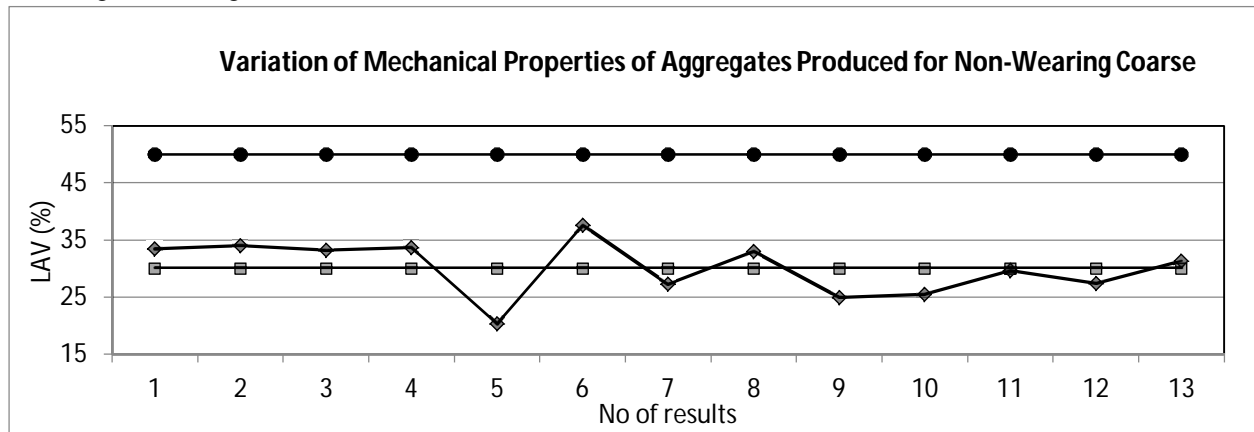


Fig 3

Crushed fine aggregate samples were collected from both the processing plant and tested for percentage of particles passing in 75 micron sieve. The variation as in the fig 4 was having numbers of peaks and dips, which reveal that there was no uniformity while manufacturing crushed sand. In the crushing process, lot of finer fraction was produced and controlling this was a challenge. The graph indicated that in two occasions it exceeds the acceptance criteria. However corrective measures were taken to bring down the percentage passing of the 75 micron particle size within acceptance limit.

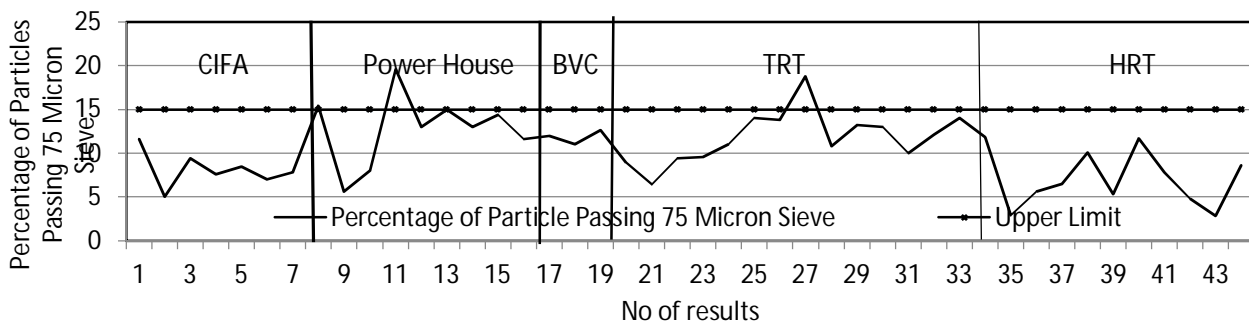


Fig 4

Four grades of concrete mixes were analyzed and variations of concrete cube strength were analyzed as shown in fig 5 to fig 8 and in fig 9 qualitative comparison of all four grades of concrete in respect of standard deviation and acceptance criteria as shown. Maximum standard deviation was 1.1 MPa and minimum 0.4 MPa which indicates that degree of quality control was excellent.

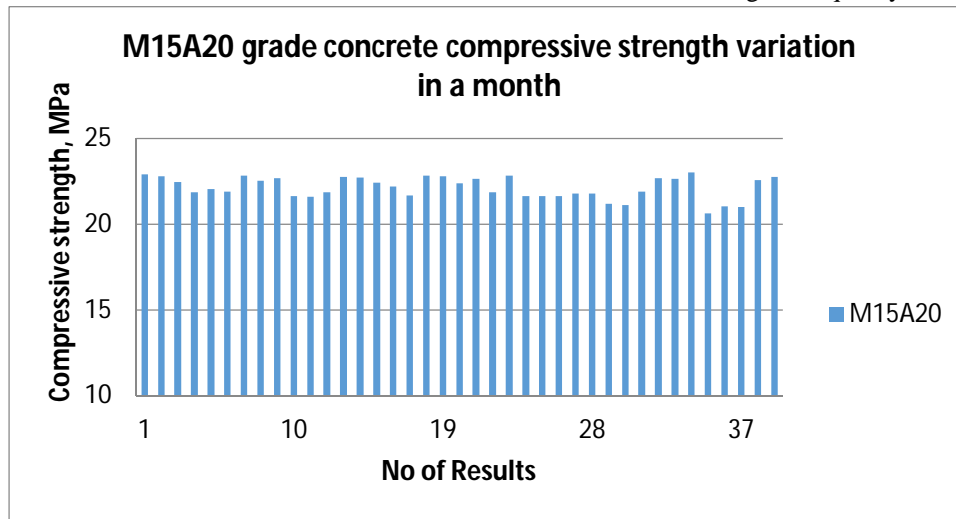


Fig 5

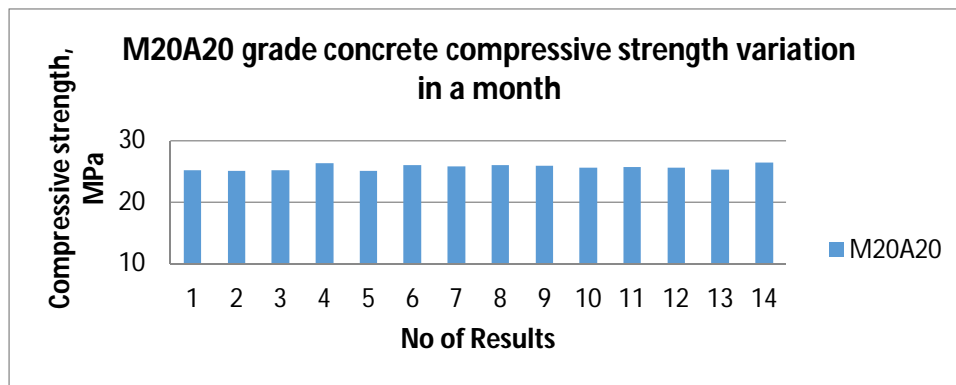


Fig 6

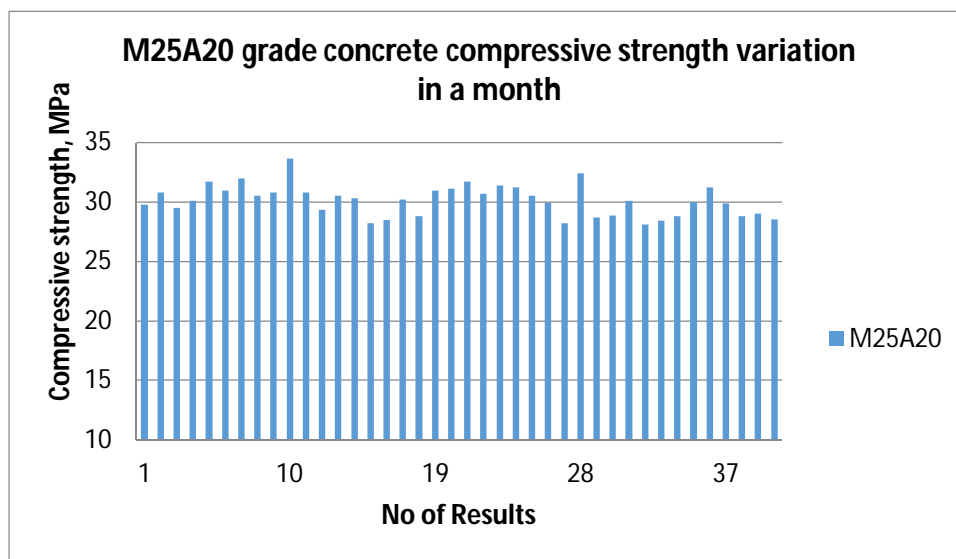


Fig 7

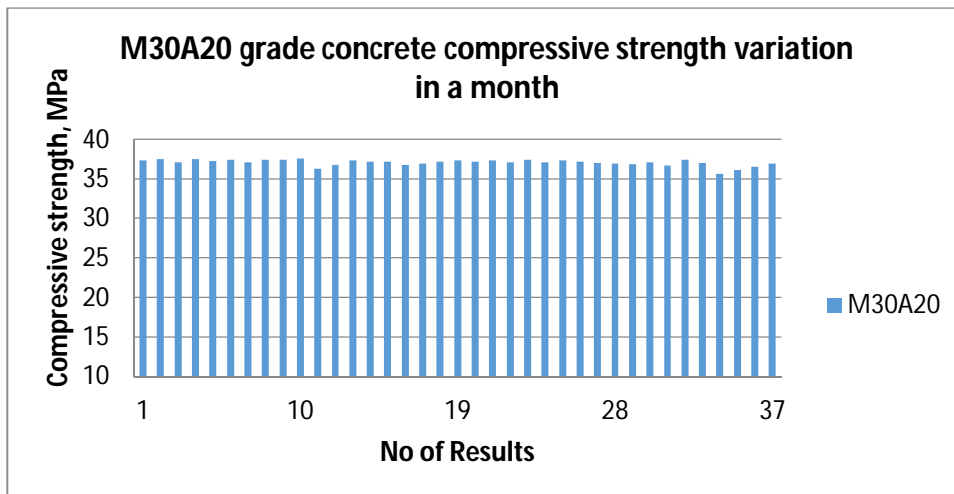


Fig 8

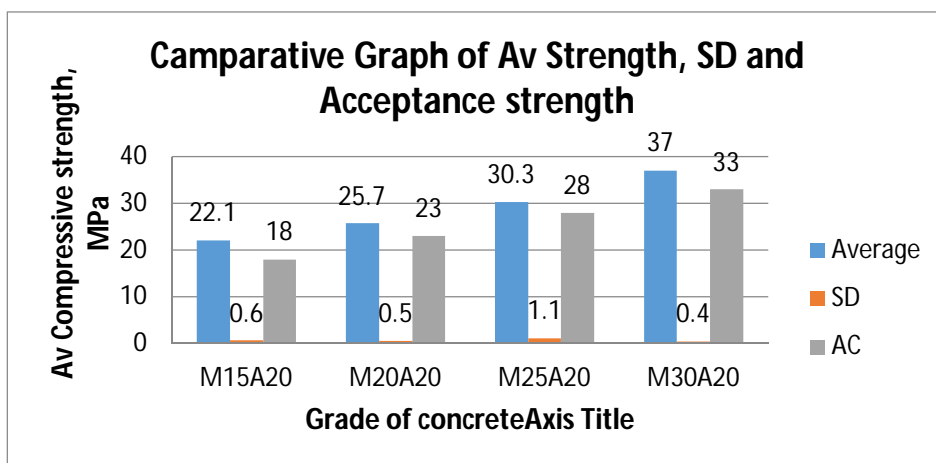


Fig 9

Maximum standard deviation observed in M25A20 mix. Hence, consider this data for further analysis.

The Shewhart chart has a horizontal central line of mean value of the test results of concrete. The upper warning limit (UWL) and lower warning limit (LWL) are set at a level i.e 2σ , so that most of the results will fall between the lines when a system is running in control.

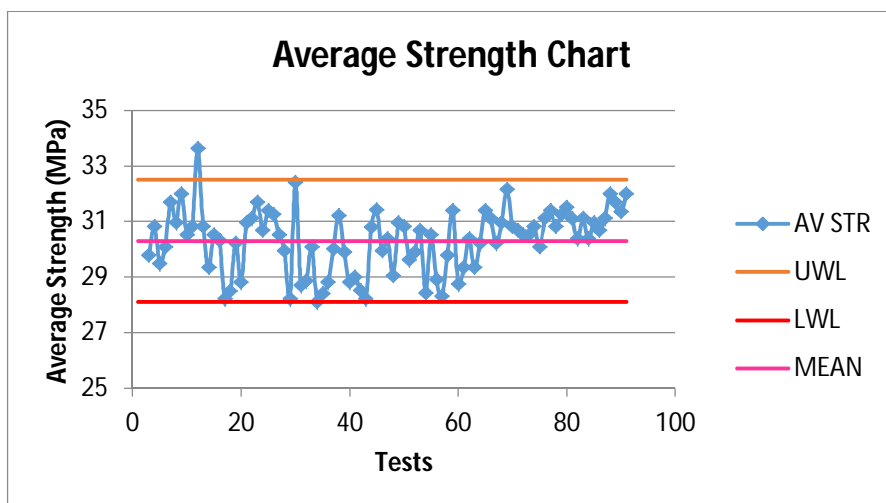


Fig 10

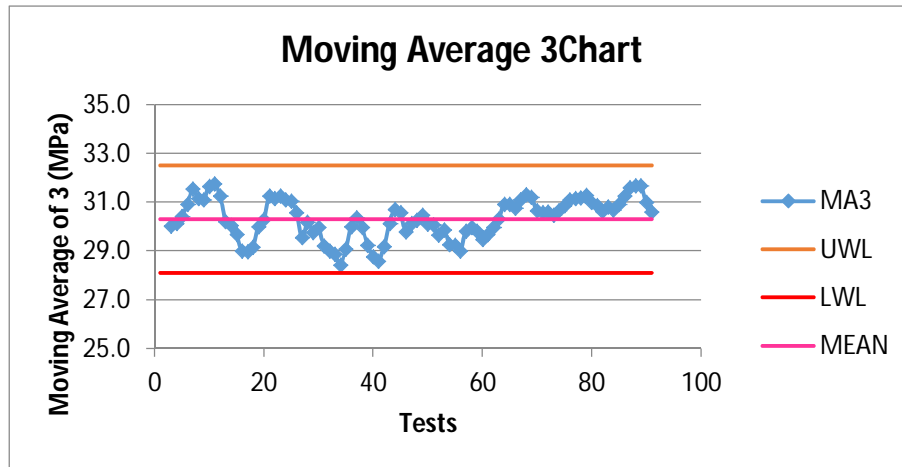


Fig 11

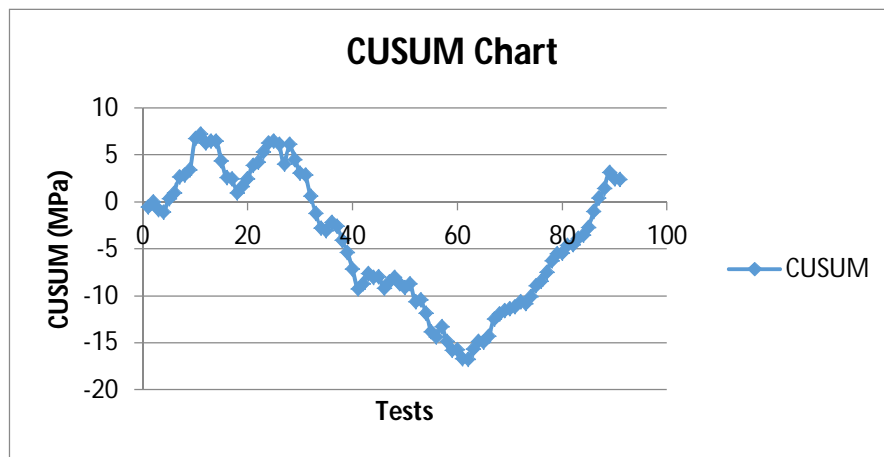


Fig 12

III. CONCLUSION

This study concludes that production quality of concrete was maintained. Though, this analysis was done on one grade of concrete mix which was having maximum standard deviation amongst the other considered mixes. Few peaks in average strength were observed but overall all data are within $\pm 2\sigma$. Micro variation was observed in CUSUM chart but successive improvement also noticed. Quality cannot fully accomplish its objectives unless it is uniformly interpreted and enforced. Uniformity in interpretation and enforcement can only be achieved through proper knowledge of what is involved in statistically adopted variables [4].

REFERENCE

- [1] Ajay V. Chopane1 and Dr. Abhay S. Wayal2 “Evaluation of Quality of Concrete Road Project based on Statistical Quality Control Techniques” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 13, Issue 5 Ver. V (Sep. - Oct. 2016), PP 88-92
- [2] Mohamed Aichouni, Nouredine Ait Messaoudene, Mabrouk Touahmia, Abdulaziz Al-Ghonamy “ Statistical analysis of concrete strength variability for quality assessment: Case study of a Saudi construction project”. International Journal of Advanced and Applied Sciences, 4(7) 2017, Pages: 101-109
- [3] Quality control lecture note 2
- [4] Arshad Rashid, Dr.Pradeep Patil” Applications of Statistical Quality Control Tools in Construction Industry a Quality Approach” August 2016 IJSDR Volume 1, Issue 8, pp 278-284



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