Quality Management System Of Concrete Production

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Abstract:

The Quality Management System (QMS) in construction industry refers to quality planning, quality assurance, quality control. The main aim of construction industry is to make certain that construction projects are successfully completed within the restriction of best quality, stated period and at minimum possible cost. The research based on QMS endorse that construction companies should create a flexible and good organizational atmosphere which encourages the development of quality management system in all aspects of their work. The quality control of concrete is the most important issue in attain its desired strength and durability. The main motive of the study was to explore the existing practices on the quality control of concrete production. In doing so the main factors involved in quality control of concrete production were identified. Various questions on the factors that affect quality control of concrete production were prepared for the purpose of this study. During the survey the important information was collected by eye observation, asking question to the site engineer and from written documents kept in the site. Cement concrete has been used as a structural material since Roman times but it is only within the last century that the difficulty of this misleading simple, common material have come to be appreciated. In the broadest sense, any mixture of aggregates, cement and water can be regarded as concrete, but in normal usage concrete means a plastic, workable mixture, in controlled proportions of cement, water and both fine and coarse aggregates, prepared for use in construction.

Keywords: Quality control, Concrete, Strength, Durability.

1.Introduction:

Quality Control is very crucial to build tough and efficient structures in the construction industry. To maintain the quality on site Quality Control and Quality Assurance are very important.. Total Quality Management (TQM) is the concept mostly used in the manufacturing industry but it shows its importance in the construction industry also. The strength of the structure is a random variable, it is necessary to exercise good quality control to minimize its variability.

Due to its versatility in use Concrete is a mostly used component of most of our infrastructural facilities today in the 21st century. Concrete is used more than any other man-made material in the world .Concrete is generally produced in batches at the site with the locally available materials of variable characteristics. It is, therefore, likely to be variable from one batch to another. The magnitude of this variation depends upon several factors, such as :

(a) variation in the quality of constituent materials ,

(b) variation in mix proportions due to batching process,

(c) variation in the quality of batching and mixing equipment available,

(d) the quality of overall workmanship,

(e) supervision at the site is also a man factor.

Moreover, concrete undergoes a number of operations, such as transportation, placing, compacting and curing . During these operations many variations occurs partly due to quality of plant available and partly due to changes in the efficiency of techniques used. Thus there are no unique assign to define the quality of concrete entirely. In this situation concrete is generally referred to as being of good, fair or poor quality. This explicate is subjective. It is, therefore, necessary to define the quality in terms of craving performance characteristics, economics, aesthetics, safety and other factors. Due to the large number of variables influencing the performance of concrete, quality control is an involved task. Therefore, the aim of quality control is to decrease the above variations and produce uniform material providing the characteristics advisable for the job fantasy. Thus quality control is a corporate, dynamic program to assure that all aspects of materials, equipment and workmanship arc well looked after. In these areas tasks and goals are properly set and defined in the specifications and control requirements. The specifications have to state clearly and definitive the steps and requirements, compliance to which would result in a construction of allowable quality. Except for compressive strength and appearance there is no early measure of construction performance. Each step in construction procedure is therefore to be designate. The probability based specifications containing allowable tolerances on its attributes is more rational and is preferred. Quality control is thus compliance to the specifications, not more not less. The most practical method of effective quality control is to check what is done in totality to conform to the specifications. An owner will have no right to expect anything more than what is in the specifications. The builder, on the other hand, knows that anything less than what is in the specifications will not be acceptable to the owner. The main objective of the study is to assess the present practices for the quality control of concrete production.

1.1 Need for improved concrete quality: All sectors of society there are growing demands for improvements in the quality of manufactured products and nowhere is this demand more regularly heard than in the construction industry. Clients are no longer prepared to accept poor quality structures which suffer enormous repair and maintenance costs during the life cycle of the building. To maintain its position in the industry the most important thing for concrete is as the most important basic material in the building and civil engineering industry, concrete quality needs to be improved to reduce high repair and maintenance costs of concrete structures, so satisfying the requirements and desires of the client.

1.2 Objectives: The following objectives are:

a) To establish what the most common concrete failures and defects are and to determine the primary causes of these.

b) To determine what compose quality concrete and establish what factors are required to produce it.

c) To establish if contractors use effective quality management to make sure the production of quality concrete.

1.3 Methodology: The working methodology of the study was followed as given below:

a) Identification of key factors involved quality control of concrete production.

b) Preparation of various questions on the factors that affect quality control of concrete production.

c) Collection of data from under construction project in Dhaka city on the quality control of concrete production.

d) Examine field data.

e) Conclusion on the examine and necessary recommendation.

2.Quality of Concrete:

In most industries especially in manufacturing and processing, the concept of quality control is old and used considerably. Nowadays, application of quality control is not only becoming popular but also compulsory in construction industry. Just knowing some quality control methods or procedures will not do any good. We must have to adopt and implement the quality control methods and tools that are available to us. The concept and its practice must be tuned in pleasant sound. Quality control in construction activities guides the execution of correct structural design, description and proper materials ensuring that the quality of workmanship by the contractor /sub-contractor is achieved.

2.1 Factors affecting in the quality of concrete: In view of the different processes involved in the manufacture of concrete, the problems of quality control are expand and their solution intricate. The factors involved are the personnel, the materials and equipment, the workmanship in all stages of concreting, i.e. collection of materials, mixing, transportation, placing, compaction, curing, and finally testing and inspection. It is therefore necessary to examine the different factors causing imbalance in the quality and the manner in which they can be controlled.

Materials: For a equal quality of concrete, the ingredients (particularly the cement) shall ideally be used from a single source. When ingredients from different sources are used, the strength and other characteristics of the materials are likely to change and, therefore, they should only be used after proper estimation and testing.

a) Cement: Cement is any material that hardens and becomes strong cohesive after application in plastic form. Cement is the unbreakable constituent of concrete. Similar types of cement from different sources and at different times from the same source reveal variations in properties of concrete, especially in compressive strength. This change in the strength of cement is related to the formation of raw materials as well as changes in the manufacturing process. The cement shall be tested initially once from each source of supply and, eventually, at every two months interval. Sufficient storage under cover is necessary for protection from moisture. Set cement with hard block is to be rejected.

b) Aggregates: In any concrete, aggregates (fine sand and Coarse) mostly occupies about 72-75% and between 65 – 85% of the total volume of the concrete mass. The aggregates have to be graded so the whole mass of concrete acts as a relatively solid, homogeneous, dense combination with the smallest particles acting as inert filler for the voids that exist between the larger particles. This therefore suggests that the selection and division of aggregates shall be given due attention as it not only affects the strength, but the strength and structural performance of the concrete also. Further, the aggregate is reasonable than cement and thus it is cheaper to use as much quantity of aggregate and as little of cement as possible. Aggregates provide better strength, stability and durability to the structure made out of cement concrete than cement paste alone. Aggregate is not truly inert because its physical, thermal and chemical properties effect the performance of concrete. While selecting aggregate for a particular concrete, the economy of the mixture, the strength of the hardened mass and durability of the structure must first be considered. The major source of variability are grading, maximum size ,shape, and moisture content of the aggregate. Aggregate shall be separately stock piled in single sizes. The graded aggregate should not be permit to segregate.

c) Water: The water which we used for mixing concrete shall be free from silt, organic matter, alkali, and suspended impurities. Sulphates and chlorides in water should not be greater than permissible limits. Generally, water which was fit for drinking may be used for mixing concrete.

2.2 Workmanship: Batching of materials, mixing, transportation, placing, compaction, curing and finally testing and inspection are all activities involved in the workmanship in all stages of concreting.

a) Ready mixed concrete: If instead of being batched and mixed on site, concrete is convey for placing from a central plant, it is referred to as ready-mixed or pre-mixed concrete. This is used for large batches with truck transporters up to 6m3 capacity. It has the advantage of remove site storage of materials and mixing plant, with the guarantee of concrete manufactured to quality-controlled standards. Placement is usually direct from the lorry therefore site-handling facilities must be co-ordinate with deliveries. Advantages of Ready-Mix Concrete:

a) Close quality control of batching which decrease the division of the desired properties of the hardened concrete.

b) Use on crowded sites or in highway construction where there is little space for a mixing plant and aggregate accumulation.

c) Use of agitator trucks to ensure care in transportation, thus preventing segregation and maintain workability. d) Satisfaction is when small quantity of concrete or irregular placing is required. The disadvantage of ready-mix concrete is that it is costlier by about 12 – 15% than concrete mixed at project site. But this is often off-set by savings in site organization, in supervisory staff, and in cement content.

b) Concrete mix ratio: While making concrete it is important to use the right concrete mixing ratios to produce a strong, durable concrete mix. Mixing water with the cement, sand, and stone will form a paste that will combined the materials together until the mix hardens. The strength properties of the concrete are inversely proportional to the water/cement ratio. It means that more water you use to mix the concrete (very fluid) the weaker the concrete mix. The less water you use to mix the concrete (somewhat dry but workable) the stronger the concrete mix. Exact concrete mixing ratios can be achieved by measuring the dry materials using scuttle or some other kind of measuring device. By measuring the mixing ratios you will have a compatible concrete mix throughout your entire project.

c) Batching of concrete: The exact measurement of the various materials used in the concrete mix is called batching. Errors in batching are generally responsible for the variation in the quality of concrete. Concrete can be batched in two ways:

1) Volume batching

2) Mass (weight) batching.

Weigh-batching of materials is always preferred than volume batching. If weight-batching is not possible than the aggregates are batched by volume, such volume measures to be regularly checked for the weight-volume ratio.

d) Mixing of concrete: This is the practical means of producing fresh concrete and placing it in the form so that it can harden into the structural or building material referred to as concrete‘. The sequence of operation is that the correct quantities of cement, aggregates and water, possibly also admixture are array and mixed in a concrete mixer which produces fresh concrete. This is transported from the mixer to its final location. The fresh concrete is then placed in the forms, and flatten so as to achieve a heavy mass which is allowed and helped, to harden. The impartial of mixing of concrete is to coat the surface of all aggregate particles with cement paste and to mix all ingredients of concrete into a uniform mass. Mixing of concrete is done either by hand or by machine. Mixers performances shall be checked for abidance with the need of the pertinent standards. Concrete shall be mixed for the required time; both under-mixing and over-mixing shall be avoided.

e) Transportation: After mixing, concrete shall be shift and placed at site as soon as possible without segregation, drying, etc. As speedly as concrete is discharged from the mixer, internal as well as external forces starts acting to divide the variant constituents. If over-weight concrete is constricted in regular forms, the lighter and heavier particles tend to settle and finer and lighter materials tend to rise. If concrete is to be shifted for some distance over rough ground the runs shall be kept as short as possible since vibrations of this nature can cause segregation of the materials in the mix. For the same reason concrete should not be dropped from a height of more than 1m. If this is assured a chute shall be used. The green concrete shall be handled, shifted and placed in such a manner that it does not get separate. The time interval between mixing and placing the concrete shall be decreased to the minimum possible.

f) Placing: The formwork and location of reinforcement shall be checked before placing concrete to make sure that they are clean and free of any debris, such as ends of tying wire. The fresh concrete shall be placed as close as possible to its eventual position. Care need to be taken when release concrete from skips to keep away displace the reinforcement or over filling the formwork. When filling columns and walls, care shall be taken that the concrete does not beat the face of the formwork, which might influence the surface finish of the deadened concrete. For deep sections the concrete shall be settled in constant layers, typically not more than about 500 mm thick, each layer being fully condense.

g) Compaction: Compaction of concrete is the process embrace for remove the entangle air form the concrete. In the process of situate and mixing of concrete, air is likely to get snare in the concrete. If this air is not deplaned out fully, the concrete losses strength considerably. Forecast targets of strength, impermeability and durability of concrete can be attain only by detailed and sufficient compaction. One per cent of the air voids left in concrete due to incomplete constricting can lower the compressive strength by nearly five percent.

h) Curing: Curing of concrete is the process of sustain acceptable moisture content and a approving temperature in concrete during the period instantly after the deployment of concrete so that hydration of cement may continue till the crave properties are developed adequately to meet the necessity of service. The reasons for restore concrete are to keep the concrete soaked or as nearly saturated as possible, until the originally water filled space in the fresh cement paste has been filled to the crave range by the product of hydration of cement, to stop the loss of water by evaporation and to continue the process of hydration, to reduce the shrinkage of concrete and to secure the properties of concrete. Adequate curing is essential for the manage and enlargement of power of concrete. The curing time depends upon the shape and size of member, atmospheric temperature and humidity conditions, type of cement, and the mix proportions. Nonetheless, the first week or ten days arc the most censorious, as any drying out during this young age can cause irrevocable loss in the quality of concrete. Generally, the long-term compressive strength of concrete moist restore for only 3 days or 7 days will be about 60 per cent and 80 per cent, respectively, of the one moist cured for 28 days or more.

2.3 Formwork: Formwork is a structure, usually non permanent, used to contain poured concrete and to matrix it to the required dimensions and carry until it is able to support itself. It made up of firstaly of the face contact material and the messenger that directly support the face contact material. Proper removal of formwork is an important factor to attain good quality of concrete during the service life.

2.4 Inspection & testing: Inspection and testing play a essential role in the all inclusive quality control process. Inspection could be of two types, quality control inspection and receipt inspection. For frequent operations early inspection is essential, and once the plant has stable, occasional checks may be enough to make sure continued satisfactory results. The operations which are not of boring type would require, on the other hand, more continual survey. Apart from the tests on concrete materials, concrete can be tested both in the fresh and hardened states. The tests on fresh concrete offer some chance for required corrective actions to be taken before it is finally placed. These include tests on workability, unit weight or air content (if air-entrained concrete is used), etc.

3. Result and Discussion:

Quality of concrete depends on the comonent materials, their share, mixing, transporting, placing, compression and curing of concrete. The concrete with proper mix proportion has the needed workability and develops the decided compressive strength. Well organised concrete mixers are require to mix the ingredients and to manufacture a sticky and workable concrete. Once the concrete is planted and combined by compaction in the formwork, preserved and restore properly, it shall be a good quality concrete and is look for to perform satisfactorily in the service life.

3.1 Strength Testing Results :

Compressive and splitting tensile strength tests were performed at 1, 3, 7, and 14 days. At each time, two specimens of each type were tested or checked. The record of strength or say hardiness development with time as well as the actual mix proportions. Concrete strength test results are in pounds per square inch. Most of the high strength laminate specimens attain a 14-day compressive strength of nearby 7500 psi, and a one-day strength of nearly 3500 psi. In contrast, the normal strength specimens gain one-day strength of approximately 2000 to 3000 psi, and 14-day strength of 3500 to 5000. In both cases, the 14day strength evolve by the specimens with fly ash was much lower. Only the normal strength laminate designs with fly ash or slag substitution would have failed to meet that criterion.

The cleave tensile strengths followed same trends, but there was more separate. With the deviation of the normal strength laminate designs with fly ash or slag substitution, all had chop tensile strengths between 300 and 600 psi at one day, and between 450 and 850 psi at 14 days.

3.2 Bond Testing Result: There was appreciable divergence in the ulfaltering bond strength. Bond strength increased between one and three days, although the increase (if any) at 7 and 14 days was less transparent. Bond testing was subject to appreciable scatter. In part this was due to the changable nature of bond, and in part due to testing. A pull-off specimen might have failed in five different ways. The disk might fail where it is devoted to the laminate with epoxy, either in the epoxy or in weak concrete at the surface. The laminate might rupture, or the base concrete might fracture. Finally, the crave failure mode, detachment of the overlay from the base concrete, might occur. The last non-sucess mode was the only one that give an correct measurement of the bond strength between the overlay and the base concrete. The others all gives a lower bond measurement, because in those non-sucess modes the bond did not fail, but remained complete.

3.3 Durability:

The opposition of concrete to frozen and unfreeze cycles is an important measure of longevity. Freeze-thaw tests were execute to regulate the longevity of the concrete mixtures used in this test plan. The concrete specimens were open to quickly repeated cycles of frozen and unfreezing in accordance with ASTM C666 (1997). Procedure A, quickly freezing and thawing in water, was followed in the laboratory to execute the tests. This procedure does not give any numeric measure of the service life that can be anticipate of a particular mix type, but can be used to specify the disparity in both properties and determine of concrete samples. The freeze–thaw tests were transfer out on beam samples made from the same concrete mixed for the laminate specimens. After curing these samples for 14 days in a water tank, they were shift to a freezer. The beams were kept in the freezer until enough samples of each mix type were obtainable to run the freeze-thaw machine. This was done to continue the uniformity of the test.

During the test, beam specimens were separate from the freeze-thaw machine at meantime not considerable 36 cycles of display. At the end of each meantime the machine was cease while it was in the unfreeze cycle. To make sure that the specimens were completely defrost and preserve at the described temperature, they were kept in the freeze-thaw apparatus for a day. The beam specimens were then extract and water was used to clean them free of scale, than they were put into a water tank for 4 to 5 hours. Calculation of length change, cross sectional dimensions, weight loss and elemental transverse frequency were construct after mop the specimen surface free of surplus water. The stainless steel vessel were also cleaned free of the scale with water, and comeback to the freeze-thaw machine along with the specimens.

4. Conclusion:

This study gives appreaciation of the existing practices for quality control of concrete manufacture. From the finite range of current study the following termination can be drawn.

a) Almost all of the construction sites continue their concrete mix ratio by volume batching. The water-cement ratio is keep from the practical experience of the person bothered.

b) The only method in which quality concrete can be construct is if all the specified necessity are observe to. Affirmation of the necessitate conformity can only be attained by means of effective quality management.

c) All of the concrete designs tested have sufficient mechanical properties, bond strength, and durability. The normal strength concrete is more cheap than the high strength concrete, but expand these properties more steadly.

d) Performance of concrete also pivot on surface composition and curing. If these are abandon, even the best-designed materials may fail. Administration of laminate temperatures at early ages is important. Thus, knowledge of forecast environmental conditions during establishment can help avoid early-age behavior problems.

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