International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

"Quality Management in Concrete for Residential Buildings"

Parag S. Sonawane[1], Prof. P J. Wankhede[2]

[1]*Department of Civil Engineering, SSGB COET, Bhusawal – 425201, Maharashtra, India*

[2]*Department of Civil Engineering, SSGB COET, Bhusawal – 425201, Maharashtra, India*

Submitted: 10-05-2022 Revised: 15-05-2022 Accepted: 18-05-2022

ABSTRACT-This paper includes the role of formwork in high- rise residential building construction and analyzes this role in shaping not only the progress of concrete activities. In paper how formwork is important to archive a good quality of concrete is disused. Formwork is the term used for the process of creating a temporary and permanent mound into which concrete is poured and formed. Concrete production process is a major activity in construction industry and good quality of concrete manufactured by the use of the Ready Mixed Concrete (RMC).In RMC bathing of material and transit mixture (TM) is a major activity which gives a good quality of concrete. Calibration of the RMC plant insures exact batches of material get which is important in achieving good concrete. The concrete shall be placed as soon as possible after delivery from the RMC. Concrete shall be placed from the sufficient height to avoid the segregation in concrete. Strength of concrete can be achieved by the good curing of concrete member. Curing by the wet covering is best method of curing in the construction industry. Quality management is the combination of all Quality Assurance (QA) and Quality Control (QC) activities used to attain the quality required for the contract deliverables. Quality management includes all planned and systematic actions necessary to provide assurance that all products and constructed works will meet established parameters and customer satisfaction.

I. INTRODUCTION

Concrete is the most worldwide of all the construction material because of the most economical one and is strong and durable material. The development made by the construction industry of any country could be considered as the index of development of that country. The construction industry is the second largest industry in India after agriculture. In construction industry concrete is one of the major components of a structure, particularly a multi-storied structure, where in it accounts for 30% - 50% of the total cost. In recent work of the construction industry there is increase in ignorance of the concrete and its activities. Concrete production process required good quality of supervision to achieve durable concrete.

In construction industry, the freshly cast concrete elements like slabs, shear columns beams, walls are usually supported temporary by a system of formwork until the imposed loads can be carried by the concrete structure itself. The quality of formwork is highly important to get the good quality of concrete member in shape and size. RMC is a system in which the cement aggregates and other ingredients are weigh-batched at a plant and mixed in a central mixer or truck mixer, before delivery to the construction site. In RMC fresh concrete is manufactured in a plant away from the construction site and transported within the estimated journey time. Fresh concrete is hardened after placing and then curing of the member is vital for getting the required strength concrete. The quality management is a corporate, dynamic program to assure that all the aspects of materials, equipment, and workmanship are well looked after.

II. LITERATURE SURVEY

Hisham A. Ibrahim and Farook R. Hamzeh (2015) stated that formwork play a dynamic role in leading high-rise construction, and technological advancements. For best quality of finished concrete, it is better to use good quality formwork system. Smooth surface of formwork helps in the time of removing the formwork from concrete surface.

Sasikumar.M and Dhayanandhan. B.V (2017) stated that Quality Control of RMC can be

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

divided into three convenient areas like forward control, immediate control and retrospective control. Quality of RMC plant is depending on incoming material tests, standard QC lab in site, quality control team and quality process.

Shrikant M Harle(2017) explained about the various method of placing of concrete in his paper.

In pumping of concrete required less labour intensive than other placing method and get job completed more quickly, labour productivity during pumping is roughly twice that of crane or hoist.

Prerna Tighare, Mr. R. C. Singh (2017) stated various method of curing of concrete. If curing is neglected in the early period of hydration, the quality of concrete will experience permanent loss of strength. Conventional water curing is the most efficient method of curing as compared to membrane curing, Self-curing, Wrapped curing and Dry air curing methods which is used in the construction field. Use of curing compounds resulted in strength up to 85 to 90 % by ponding method.

P.D.Rwelamila and G.T. Wisemant(1995) stated that the only way in which quality concrete can be produced is if all the specified requirements are conformed to. Assurance of the required conformance can only be achieved by means of effective quality management. A quality management system benefits both the client and the contractor. The client is assured of a quality structure which conforms to all the specified requirements and so should be free from unnecessary repair and high maintenance costs.

According to the P.P.Mane and J.R.Patil (2015)

The quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a construction project. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the construction project.

III. QUALITY MANAGEMENT IN THE CONCRETE PRODUCTION PROCESS

Concreting process incudes following activity formwork, batching, mixing, transporting, placing and curing of concrete.

A. Formwork

Formwork is a die or a mould including all supporting structures, used to shape and support the concrete until it attains sufficient strength to carry its own weight. It should be capable of carrying all imposed dead and live loads apart from its own weight. Formwork has been in use since the beginning of concrete construction.

In other words "Formwork is a structure, temporary which is designed to remain concrete in position. Form it into the required shape and dimensions. Support it until it cures sufficiently to become self-supporting."

The term formwork" includes the actual material contact with the concrete, known as form face, and all the necessary associated supporting structure. Formwork is significantly vital activity for concreting work. Good quality of formwork can contribute a great for good quality of concrete work. It not only holds the concrete during its wet stage but do many other important functions in this activity of concreting work. Bad formwork has often born failures of minor as well as major defect.

1) Requirements of Formwork

(i) Safety and Integrity

The formwork shall be planned with safety of permanent constructions and workers. It shall be adequately braced laterally and diagonally.

(ii) Rigidity and Deflection

Formwork shall be rigid enough so that the deflections under the dead load and live loads and forces caused by vibration of concrete and other incidental loads imposed upon it during and after casting of concrete are well within its limits. The rigidity can be achieved by suitable number of ties and braces to the formwork of the casting member. Screw jacks or hard board wedges, where required shall be provided to control formwork settlement.

(iii) Strength and Stability

The formwork shall be of adequate strength and so as to withstand all anticipated loads including lateral loads, vibrations and small accidental loads. The system shall be such as to avoid tolerant failure due to minor causes.

2) Functional Requirements

(i) Erection and Release

Formwork shall be so designed and constructed that they can be removed in parts in the desired sequence without damaging the surface of concrete or disturbing other sections or causing collapse of the formwork systems. Collapse of the formwork that cause a defective formwork and after reuse of the formwork defective concrete member casted. The connections joining various components of the formwork should be capable of being easily removed while formwork stripping.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

(ii) Ease of Inspection

The system of formwork should facilitate adequate and safe access to all areas for inspection of concrete member.

(iii) Shape and Size

The formwork shall be erected such that the shape and dimensions of the concrete structures are Conforming to the drawings, the specifications and tolerances specified in the diagram. Shape and dimensions of concrete member depends on the formwork system. Defective formwork system causes a bulging in the concrete member, that's affect, the quality of the concrete member and increase in the cost of the rectification.

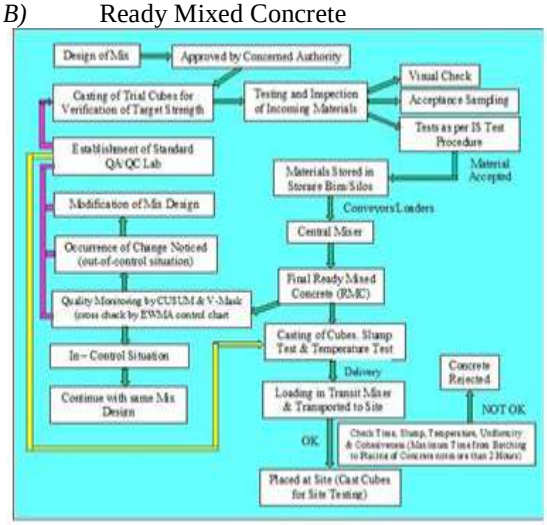
(iv) Finish

The formwork should be solid enough so as to not to get damaged due to operations of reinforcement fixing, pouring and vibrating of concrete and removal of forms. The materials of formwork shall depend upon the finished surface required.

(v) Reuse

It shall be designed and planned to permit maximum reuses, reducing the cost of concrete work. While avoiding unsafe or poor practices, adequate planning shall be done right from initial stages to develop a viable reuse plan, utilizing member sections and sizes that will involve minimum material cutting, wastage and minimum assembly.

B) Ready Mixed Concrete



In order to ensure that concrete produced is of anticipated quality, it is necessary that quality control is exercised at all the stages right from receiving of raw material to delivery of concrete at site. Thus, while planning to use Ready Mixed Concrete (RMC), it should be ensured that producer of RMC has accepted quality assurance program.

(i) materials storage
(ii) monitoring of quality of materials
(iii) modification of mix design
(iv) Plant maintenance
(v) calibration of equipment and
(vi) plant and transit mixer condition

i) Batching

Batching quality is mainly depends on the calibration of the RMC plant. RMC takes separate batches of the aggregate, crush sand, fly ash, cement and admixture. All batches are collected in the hopper and mixed properly. As per the IS 456:2000 the accuracy of the measuring equipment shall be required to be within +- 2 percentage of the quantity of cement being measured and within +-3 percentage of the quantity of the aggregate, admixture and water being measured. Volume batching may be allowed only when weigh-batching is not practical at site and provided with accurate bulk densities of materials to be actually used in concrete have earlier been established. Allowance for bulking shall be made in accordance with IS 2386 (Part 3).

ii) Mixing of Concrete in RMC Plant

Before loading concrete materials into a stationary mixer or truck mixer any water retained in the mixing drum for washing out purposes shall be fully cleared. The mixing time shall be measured from the time of all the materials required for the batch is added. The mixing time shall not be less than suggested by the manufacturer. Where a continuous mixing plant is used the complete mixing time shall be sufficient that the concrete is getting uniformity.

1. Central pan mixture

This is the core of RMC plants. Here, the mix design data supplied from QA/QC department. As a procedure for various mixes i.e M 15, M 20, M 35 etc. is provided. The pan mixture is horizontal with a single or double shaft. In this pan mixture the material is feed by weight or volume. The computer controlled hydraulic jacks are used to feed each material for a particular mix design. The concrete from pan mixture is directly delivered to transit mixture.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

2. Final Mixed concrete

It is the output of a central pan mixture; here to check the quality, the cubes are casted by QA/QC departments, while the transit mixture is leaving the RMC plant. At this stage the slump & temperature is observed, if satisfactory the transit mixture is allowed to go further on the site; if not corrective measures are taken by QA/QC departments. At the time of delivery on site, samples from transit mixture is taken out, slump test is carried out, the temperature & uniformity is checked if the test found OK them only concrete is allowed to place at sites, if not OK then concrete is rejected. If the slump of the concrete is high as per the design mix then, the transit mixture is remained waited for some time and thereafter allow for pour concrete. Rejected concrete is taken back to RMC plant, investigation is done & remedies are taken out such that no more such a failure should happen.

iii) Transportation

In truck mixer mixing commence from the moment when all the materials required for the batch, including water, are added in the rotating drum of the mixer. Excess load in truck mixer leads to inferior and mixing generally continued at 6-9 rpm to ensure homogeneity and uniformity in concrete material. During transportation of concrete to the site in truck mixer or agitator, concrete is generally mixed before leaving the plant, or agitated during transit and re-mixed at the site for a minimum 2 min so that the concrete is of the required homogeneity.

Where water is added to the concrete in the truck mixer through the truck mixer water meter and when such water is being accounted for in the water within the mix, it shall be ensured that the truck mixer water meter is in an operational condition and properly calibrated. Where a water meter is unavailable water must be measured in a suitable container before being added to the truck mixer. The temperature of the TM is the main factor on the evaporation of water in the concrete. Temperature of the TM is maintained by covering the rotating drum of TM by gunny bags.

(vi) Condition of mixers

Stationary and truck mixers shall be maintained in an efficient and clean condition with no appreciable buildup of hardened concrete or cement in the mixing drum, on the mixing blades, or on the loading hopper or discharge chutes. When, due to wear the height or depth of the mixing blades or paddles is less than two- thirds of the original, the blade, or paddles shall be renewed or replaced.

(vii) Time in Transport

The general requirement is that concrete shall be discharged from the transit-mixture within 2 h of the time of loading from batching plant. However, a longer period may be permitted if retarding admixtures are used in it or in cool humid weather conditions available or when chilled concrete is produced.

The, time of filling shall start from adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the wet aggregate.

C) Placing of Concrete

Ready-mixed concrete shall be transported from the mixer to the point of placing as rapidly as Practicable by methods that will maintain the required workability and will prevent segregation, loss of any material or entry of foreign matter or water. The concrete shall be placed as soon as possible after delivery and as close as is practicable to its final position to avoid rehandling and moving the concrete horizontally by vibration.

The concrete shall be deposited as nearly

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

as practicable in its final position to avoid rehandling. The concrete shall he placed and compacted he fore initial setting of concrete commences and should not be subsequently disturbed. Methods of placing should be such that it prevents segregation of concrete. Care should be taken to avoid displacement of reinforcement or movement of ironwork. As a general, the maximum allowable free fall of concrete may be taken as 1.5M.

D) Curing of Concrete Member

Curing is the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately till the desired properties develop. Satisfactory curing of concrete impact the properties of hardened concrete, increase durability of concrete, water tightness, abrasion resistance, volume stability, strength, and resistance to freezing and thawing.

Freshly mixed concrete normally contains more water which is required for hydration of the cement. But optimal temperature favours relatively rapid hydration in first few days after concrete application. Low temperature usually retards desirable strength to finished concrete. Hence, proper curing of concrete is prerequisite for stronger, more impermeable, and more resistance to stress, abrasion, and freezing and thawing. This depends on curing method adopted during concreting work. A way of curing methods is discuses below.

IV. CURING METHODS AND MATERIALS

Concrete can be kept wet and in some cases at a favorable temperature:

1. Curing methods that maintain the presence of mixing water in the concrete during the early hardening period. These include ponding or immersion, spraying or fogging, and saturated wet coverings. These methods afford some cooling through evaporation, which is beneficial in hot climatic condition.
2. Methods that reduce the loss of mixing water from the surface of the concrete members. This can be done by covering the concrete with impervious paper or plastic sheets, or by applying membrane-forming curing compounds on members.
3. Methods which accelerate strength improvement by supplying heat and additional moisture to the concrete members. This is usually accomplished with live steam, heating coils, or electrically heated forms or pads.

1. Ponding and Immersion

Ponding is preferred method for flat surfaces, such as pavements and floors to prevent loss of moisture from the concrete at uniform temperature in the concrete.

Fig: Ponding and Immersion

2. Fogging and Sprinkling

Sprinkling with water is a method of choice for curing when the ambient temperature is well above freezing and the humidity is low. Fogging is applied to minimize plastic shrinkage cracking until finishing operations are complete

Fig: Fogging and sprinkling of water

3. Wet Coverings

Wet coverings are placed as soon as the concrete has hardened sufficiently to (i) prevent surface damage, (ii) protect against dry out through wick which draw water out of the concrete. For this purpose, hessian cloth proved effective on vertical surfaces to distribute water evenly over the surface and reduce the rate of surface evaporation.

.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 862-868 www.ijaem.net ISSN: 2395-5252

Fig: wet covering by hessian cloth

4. Plastic Sheets

Curing of concrete with plastic sheeting is the most practical and effective way to cure concrete in construction industry sometimes water is unavailable for water curing or, if it's done wrongly, it can affect the strength and the surface finishing of the concrete member. Plastic sheet materials, such as polyethylene film, can be used to cure concrete member. Polyethylene film is a lightweight in nature, easily available, effective in moisture retarder and is easily applied to complex and simple shapes. During hot weather, white coloured sheets is used to minimize heat gain by absorption of solar radiation and, lack colour sheet is used to maximize heat gain in cold weather.

Fig: Plastic sheet covering of concrete

5. Membrane-Forming Curing Compounds

Curing Compounds are used as a curing aid for fresh concrete floors, screeds, granolithic toppings and vertical surfaces and plastered surface. Curing Compounds assists the curing process by preventing evaporation and helps to attain desired strength, durability and surface hardness with improved dust proofing qualities. Moreover, amendment with compounds seals moisture to facilitate complete hydration of cement, resulting in (a) maximum strength, (b) increase durability, (c) greater wear resistance and (d) minimum surface dusting.

REFERENCE

[1] M. Patel, J. Pitroda and J. Bhavsar (April 2015) Recent scenario in formwork: Aluminium forms. In : Proceedings on Engineering: Issues, opportunities and Challenges for Development. (ISBN: 978-81- 929339-1-7), pp.2

[2] D.S. Patil and B.D. Desaim (2016) Emerging Trends in Formwork - Cost Analysis and Effectiveness of Mivan Formwork over the Conventional Formwork, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, pp : 27-30.

[3] M.R. Rokade, N.S. Bhor, A.K. Virkar, A.R. Rode and N.S.Maid (2017). A paper on design of formwork" Intl. J. Engg. Sci. Mgt., (ISSN 2277 – 5528), vol pp 258-164

[4] S.M. Patil and R.R. Bidavi. (2017) Timber Formwork, Intl. J. Interdisci. Innov. Res., Dev. Vol. 01 (04), pp60-63

[5] G.I. Octavian (2006). Slab Formwork Design. Civil Engg. Dimen., 8, (1), (ISSN 1410-9530) pp 47–54.

[6] A.I. Hisham and F.R. Hamzeh (July 2015). Role of Formwork System in High-rise Consturction. 5th International/11th Construction Specialty Conference.

[7] S.B. Yadav, N. Kumar and R. Kumar (April 2017). "Quality control process for ready mixed concrete plants, International Conference on Emerging Trends in Engineering, Technology, science and management, VolISBN:978-93-86171-38-2. Pp. 388-393

[8] B.V. Dhayanandhan (2017). Quality control and management practice in RMC. Intl. J. Engg. Tech., Mgt. Appl. Sci., 5 (3) pp438-442….(ISSN 2349-4476 438).

[9] E.Poovaragavan and K.Chandra Sekar (2016). Continuous process improvement in Ready Mix Concrete Plants. Intl., J. Scientific and Engg. Res., 7, (4), pp263-269(ISSN 2229-5518).

[10] R. Mahajan and R. Buthello (2015). Quality control of Ready Mixed Concrete. IOSR Mechan. Civil Engg., 12 (5), pp : 01-07

(ISSN: 2320- 334X)
[11] H.P. Naiknavare, S.D. Deshpande and R.D. Padhye . Model chart of quality control process for Ready Mixed Concrete Plants. IOSR Mechan. Civil Engg., pp : 50-54 (ISSN: 2278-1684)
[12] S.M. Harle (2018). Different methods of placing concrete. Intl. J. Adv. Sci. Res., 3 (1), pp : 17-22 (ISSN: 2456-0421).
[13] T. Gokul, M. Arun and N. Arunachalam (2016). Effects of different types of curing on strength of concrete. Intl. J. Innov. Res. Sci., Engg.Techno., 5 (2), pp :1643-164
[14] P.P.Mane and J.R.Patil (2015). Quality Management System at Construction Project: A Questionnaire Survey. Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 5, Issue 3, (Part -3) March 2015, pp.126-130
[15] P.D.Rwelamila and G.T. Wisemant(1995) Concrete quality management: a research study of the general contractor in South Africa, Consrruction and Building Moteriuh Vol. 9. No. 3, pp. 173-183, 2014.