READY MIXED CONCRETE MANUFACTURERS' ASSOCIATION – (RMCMA)

(Bulletin No. 14)

Guidelines for Handling Fresh Concrete at Sites

PRESIDENT'S MESSAGE

Dear RMCMA Members,

I am pleased to introduce this month's bulletin on "Handling of Fresh Concrete at Construction Sites," a topic that bridges the gap between our manufacturing excellence and on-ground construction reality.

As manufacturers of ready-mixed concrete, our responsibility extends far beyond the batching plant. The highest quality concrete produced at our facilities can only deliver its intended performance when handled, transported, placed, and cured properly at the construction site. This critical "last mile" of concrete delivery often determines whether a structure will achieve its design life or face premature deterioration.

In my interactions with members and site engineers across the country, I have observed that improper handling practices-be it excessive delay in placement, improper vibration, inadequate curing, or unauthorized addition of water-remain significant challenges that compromise concrete quality. These issues not only affect structural integrity but also reflect poorly on our industry's reputation, despite our best efforts at the production stage.

This bulletin addresses these practical challenges systematically, providing clear guidelines on transportation time limits, placement techniques, consolidation methods, finishing practices, and curing protocols. It also covers critical aspects like cold weather and hot weather concreting, which are particularly relevant given India's varied climatic conditions.

I urge all members to share this bulletin widely-not just within your organizations but also with your client base, site engineers, contractors, and quality control personnel. Education and awareness are our strongest tools in ensuring that the concrete we produce with such care and precision is treated with equal diligence at the construction site.

Furthermore, I encourage our members to actively engage with construction teams, conduct site training sessions, and establish quality assurance protocols that extend to the point of final placement. Our technical expertise should be available as a resource to ensure best practices are followed consistently.

The reputation of ready-mixed concrete as a superior construction material depends on end-to-end quality management. Let us work collaboratively with all stakeholders in the construction value chain to ensure that every cubic meter of concrete we supply achieves its full potential.

Together, we can elevate construction quality standards and strengthen confidence in ready-mixed concrete across India.

Yours in service to the industry,

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1. Introduction

Concrete is one of the most versatile and widely used construction materials globally. It is typically made by mixing cement, fine aggregates, coarse aggregates, water, and sometimes admixtures to enhance specific properties. Fresh concrete, being in a plastic state, requires careful handling at the construction site to achieve the desired quality, strength, and durability in the hardened state. Proper handling ensures that the concrete maintains its uniformity, workability, and performance characteristics, ultimately contributing to the structure's longevity and safety.

(Fig-1 (a) Mechanical handling

Fig-1 (b) Manual handling

Improper handling can leads to segregation, loss of workability, or the inclusion of excess air voids, resulting in reduced strength, cracks, and durability issues. This bulletin aims to provide a comprehensive guide to construction teams for effectively managing and handling fresh concrete, ensuring that the end product meets the highest standards of quality and reliability. Mechanical handling with use of proper equipment is preferred mode of handling of concrete at site as compared to manual handling.

2. Guidelines for handling Fresh Concrete

Good quality concrete is strong, dense, adequate workable, and economical for its intended purpose. Proper handling involves steps as shown in the schematic diagram.

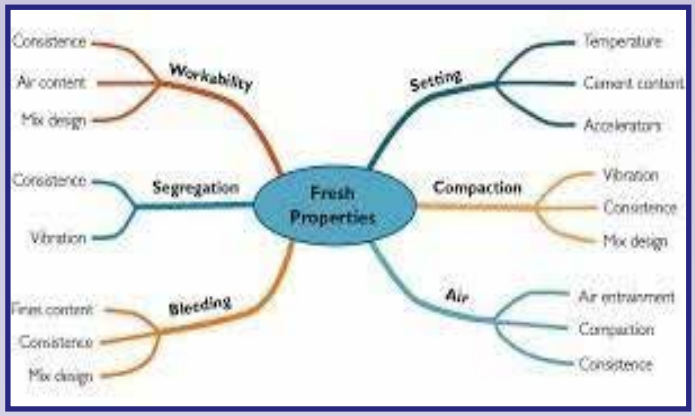

Fig 3 - Schematic diagram of various steps

2.1 Minimal Segregation: Prevent separation of coarse aggregates, fine aggregates, and cement paste during transportation and placement. Use controlled discharge and avoid dropping concrete from excessive heights not more than 1.5m and preferably 1m.

Fig 4 - Uniform spread of concrete

2.2 Effective Compaction: Eliminate air voids by using appropriate vibrators or manual tamping, ensuring uniform density and strength across the structure. In the case of columns/walls, it is recommended to pour concrete layer by layer (i.e 150 mm to 300 mm) for proper compaction.

Fig 5 - Compaction of Concrete

2.3 Proper Curing: Maintain adequate moisture levels to support the hydration process, which is essential for developing strength and durability. Initial sprinkling is important based on the initial setting time of the concrete to avoid plastic shrinkage cracks.

Fig 6 - Curing of concrete

2.4 Prevent Contamination: Protect fresh concrete from external impurities like dirt, debris, or excessive exposure to extreme environmental conditions, such as direct sunlight or rain.

By adhering to these guidelines, the quality of concrete can be maintained at every stage from batching to placement. Thus ensures the desired structural integrity and durability. These requirements are described in detail in subsequent part of this bulletin.

3. Important Factors Affecting Fresh Concrete

3.1 Workability

Workability determines the ease of mixing, transporting, placing, and finishing concrete without segregation. Proper selection of admixtures and maintaining the correct water-cement ratio ensures optimal workability.

Environmental factors like ambient temperature, wind velocity and relative humidity have great influence on workability. Under severe conditions of very high/ very low ambient temperature, high wind velocity and low relative humidity, special precautions are required to achieve and maintain desired workability. The use of ice/ cold water, sprinkling of water over aggregate, use of wind breakers may be necessary under such conditions.

Workability of concrete decides the mode of compaction. While SCC may not require any compaction, on the other hand low workability concrete will require high frequency vibrations. To achieve desired results, it is necessary that workability of concrete should be checked at site before placing and if there is any variation in required and actual workability, then suitable remedial measures should be taken before placing and compaction, otherwise concrete will not be properly compacted and may also segregate.

Fig 7 - Checking of workability at site

3.2 Placing of Concrete

Placing of fresh concrete in the formwork requires systematic approach to achieve desired geometrics, strength and durability of the structures. Concrete should be placed by mechanical means like concrete pumps, buckets and hoist/crane as far as possible. On receipt of concrete at site, it should be placed as early as possible after checking its workability.

Following steps are considered important while placing the concrete :

a) Place concrete in thin layers ideally between 15-30 cm for normal reinforced concrete and 35-45 cm for mass concrete. Layers should be placed horizontally in uniform thickness. Time between laying of two layers should be closely monitored to ensure that the bottom layer is in plastic stage and both layers are bonded properly.

b) place concrete as close as possible to its final position to avoid segregation. Dragging of concrete should be avoided as it is likely to cause segregation.

c) For heights greater than 1m, use a chute or a drop shoot to prevent free fall, which can cause segregation of concrete and damage the formwork and disturb the reinforcement configuration.

Fig 8 - Placing of concrete

d) Place concrete continuously to avoid cold joints, which are weak points if two layers don't bond properly. Place concrete at required rate preferably 20m3 or more per hour to avoid cold joints. The proper rate of placing will depend upon the size of the pour and the thickness of each layer and volume of concrete delivered at site from the batching plant.

e) For large areas such as slabs, start from one corner and start from the lowest point on a slope to the highest point. The concrete placing should be started from the lowest point and progressed to the higher point in sloping structures.

3.3 Compaction

Compaction is essential to eliminate voids that can weaken the concrete structure. Use of vibrators or hand tamping ensures proper compaction, enhancing density and strength. Suitable mode of compaction should be chosen based on the actual requirement of workability of concrete.

Each layer should be properly compacted before laying the next layer. Concrete should be worked around well on the reinforcement and all corners. It should be ensured that required cover to reinforcement is maintained. Concrete should not be placed in large single deposits as uniform compaction may not be possible in such conditions.

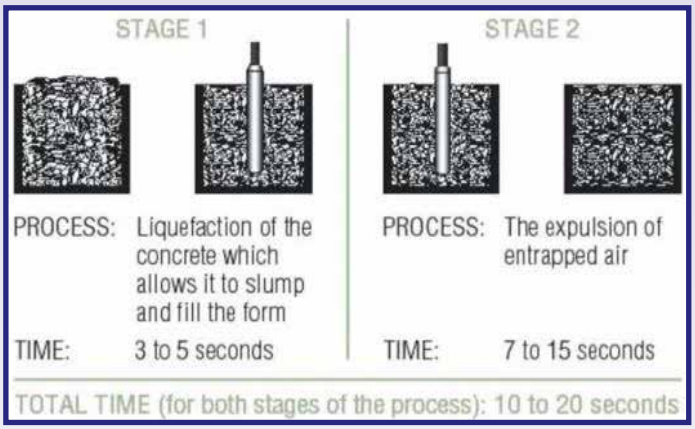

Fig 9 - Compaction of concrete

3.4 Finishing of Concrete

I) Proper Finishing Methods

Generally finishing of concrete involves three steps, screeding, floating and trowelling. For specific requirements like anti-skid and very smooth surface finishes, special tools and methods are used.

Screeding involves striking of excessive concrete by a metallic or wooden horizontal edge to achieve uniform plastic mass of concrete. Floating is done to remove the irregularities left after screeding. The large aggregate particles firmly embeds with the use of metallic/wooden floats. Floating gives a medium non-slip surface good for normal concrete which is exposed to weather and in general purpose use.

Trowelling is used to get very smooth and highly wear resistant surface by using steel trowel. Smooth surface brings water and cement particles on surface, that may adversely affect its wearing resistance. Therefore, over-troweling should be avoided. Where high wear resistance is required like in industrial floors or parking areas, vacuum dewatering process is used to remove excess water from the surface to increase wear resistance of the surface.

Note - Allow the bleed water to evaporate naturally before final finishing. This prevents surface defects and ensures a durable and proper finish.

3.5 Minimizing Bug Holes in vertical placements

(a) Use Smooth, Non-Porous Forms – Steel, aluminium or plastic-coated plywood to prevent air entrapment.

(b) Clean Forms Thoroughly – Remove dust, debris, and dried concrete from previous pours.

(c) Apply a uniform Form Release Agent – Avoid excess oil or uneven application, which can cause trapping of air bubbles.

(d) Pour in small lifts (300-450 mm / 12-18 inches) – Ensures proper consolidation.

(e) Avoid Free-Fall Placement – Use chutes, pipes, or tremies to guide concrete gently.

(f) Control Pouring Speed – Pouring too fast can trap air against form surfaces.

(g) Use a Funnel or Hopper for Congested Areas – Helps control flow and reduce voids.

(h) Insert vibrators at horizontal distance of 300 to 600 mm.

(i) Penetrate vibrator in previous layer adequately to ensure full consolidation.

(j) Withdraw vibrator slowly to avoid trapping of air.

(k) Avoid Over-Vibration which can cause segregation and surface bleeding.

(l) Use External Vibrators for Thin walls or dense reinforcement – which helps remove trapped air near surface.

(m) Tap Formwork Lightly with a Rubber Mallet – which helps release trapped air bubbles.

3.6 Curing

Curing provides the necessary moisture for the hydration process, which develops strength and makes it dense

and impermeable. Continuous water curing for at least 10-14 days is recommended, using methods such as water curing, internal curing membrane curing or other methods of curing.

Proper curing of concrete after finishing is very important especially for large flat areas like slabs to avoid plastic shrinkage cracks and to make concrete dense and to achieve required strength. Immediately after finishing concrete surface, it shall be either covered with wet hessian cloth/ burlap or any other suitable material or techniques of fogging or lightly spraying of water shall be used to avoid plastic shrinkage cracks.

After concrete is fully set, the covering can be removed (after 16 to 24 hours) and curing by water ponding should be started and continued for a period of 10 to 14 days depending upon weather conditions and use of mineral admixtures as cementitious material. Curing compounds and internal curing agents can also be used after consulting and concrete technologist and prevailing conditions at site.

Fig 10 - Curing of concrete

3.7 Cracks

Cracks may appear in fresh concrete after hardening or on opening of forms. The cracks shall be closely monitored by using suitable methods like glass strip and proper preventive measures should be used to avoid such cracks, which may be due to plastic shrinkage, autogenous, drying or thermal shrinkage. For details on cause of cracks and preventive measures, it is recommended to study RMCMA Bulletin No. 5 on "Cracks in Fresh and Hardened Concrete - Causes and Preventive Measures".

3.8 Strength

Strength depends on proper proportioning, mixing, placing, compaction and curing of concrete. Achieving the desired compressive strength is crucial for the durability and load-bearing capacity of the structure. Handling, placing, finishing and proper curing of concrete plays very important part in achieving required strength of concrete. The guidance provided in IS: 456-2000 on requirements of strength and its acceptance criteria may be referred.

4 Relevant IS Codes

Adhering to Indian Standards (IS) codes ensures uniformity and quality in concrete construction practices, from sampling to strength testing. These codes are designed to provide comprehensive guidelines for various aspects of concrete usage, ensuring consistency in results and compliance with requisite safety requirements.

Key IS Codes for Fresh Concrete:

(a) IS:1199-2018 (Part 1 to 9)

1. (Part -1) - Sampling of Fresh Concrete.
2. (Part -2) - Determination of Consistency of Fresh Concretes
3. (Part -3) - Determination of Density of Fresh Concrete
4. (Part -4) - Determination of Air Content of Fresh Concrete
5. (Part -5) - Making and Curing of Test Specimens
6. (Part -6) - Tests on Fresh Self Compacting Concrete
7. (Part -7) - Determination of Setting Time of Concrete by Penetration Resistance
8. (Part -8) - Determination of water soluble and acid soluble chlorides in mortar and concrete
9. (Part -9) - Analysis of freshly mixed concrete

(b) IS: 456 – 2000 Code of Practice for Plain and Reinforced Concrete

a. Governs general design considerations and quality control measures for plain and reinforced concrete.

b. Includes guidelines for durability, workability, and proportioning of materials and acceptance criteria of concrete.

c. Specifies requirements for curing, finishing, and maintaining structural integrity.

(c) IS: 516 - 2018

Part-1 Testing of strength of hardened concrete

Part-3 Making, curing and determining compressive strength of accelerated cured concrete test specimens.

(d) **IS: 4926-2003**

The Code of Ready Mixed Concrete under various clauses provides requirements of RMC from requirements of raw materials, production. Transportation, placing, finishing, curing and testing.

(e) RMCMA Bulletin No. 6 on "Testing of Fresh and Hardened Concrete" based on above IS Codes, provides compressive information on testing of fresh and hardened concrete.

5 Implications of Water Addition at Site

Adding water to fresh concrete increases the water-cement ratio, reducing strength and durability, therefore it shall not be added to fresh concrete at site under any circumstances. Key points to consider:

- **Slump Adjustments:** Use high-quality admixtures to adjust workability or slump instead of adding water. Consult the QC department for proper dosage and procedure for re-dosing. The re-dosing of admixture at site is now permitted by IS:456-2000 in mutual consultation of producer and purchaser. In addition, some precautions are suggested for better results to maintain desired workability of concrete at site.

Fig 12 – Remixing of concrete before discharge

- **Discharging Concrete from TM** - Before discharging, ensure the concrete in the transit mixer drum is mixed at full rpm for about 120 seconds. This reactivates the mix and helps to regain uniformity in workability.

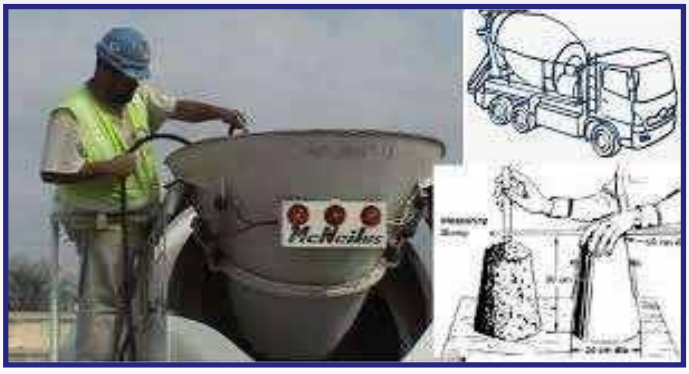

Fig 11 – Sampling of concrete

- **Quality Checks** - Take samples of concrete at regular frequency as specified in IS:4926-2003. The requisite number of samples will help in finding Standard Deviation (SD) and to keep control on quality for concrete.

By strictly avoiding water addition at the site, construction teams can prevent quality issues and ensure the concrete meets its performance criteria.

6. Casting and Curing of Cubes at Site

Do's

- Use calibrated molds confirming to IS Codes, coated with mold oil, to prevent adhesion.
- Ensure molds are tightly assembled to avoid gaps and leaks.
- Compact concrete with a 16mm tamping rod using 35 strokes per layer.
- Cast cubes under shade, protecting them from vibrations and rapid drying.
- Store cubes at 24–30°C for 24 ±½ hours before demolding.
- Cure cubes in clean water at 25–29°C, covering curing tanks to avoid direct sunlight.
- Regularly clean curing tanks to prevent algae growth and contamination.

Don'ts

- Avoid using damaged molds or improper compaction techniques.
- Do not skip uniform stroke application during compaction.
- Do not compact with inappropriate tools like reinforcement bars.
- Do not prematurely demold or cure cubes in unclean water.
- Avoid exposure of curing tanks to direct sunlight or temperature variations.
- Do not neglect cleaning of curing tanks, as unclean water may affect results.

Casting and curing practices directly influence the accuracy of strength tests and overall concrete quality, making adherence to these guidelines is essential.

7. Do's and Don'ts for Concrete Handling

Aspect	Do's	Don'ts
Water Addition	Use admixtures for slump loss by properly re-dosing.	Do not add water to adjust consistency.
Curing	Maintain moisture and Temperature (initial sprinkling is required before ponding activity).	Do not let concrete dry out prematurely.
Finishing	Allow bleed water to rise and evaporate before finishing.	Do not add dry cement or sprinkle water during finishing which leads to dusting and delamination.
Compaction	Use vibrators in a vertical position and suitable methods of compaction.	Using vibrators in inclined position leads to accumulation of fines on top of concrete.
Cube Casting & Testing	Follow IS codes for casting storage, curing and Testing.	Do not test without proper curing process.

9. Conclusion and Recommendations

Proper handling of fresh concrete is paramount in achieving quality, longevity, and structural performance. Adherence to IS codes and the guidelines outlined in this bulletin ensures minimal defects, optimal strength, and enhanced durability of concrete structures. Key recommendations include:

- **Comprehensive Training:** Equip construction personnel with the knowledge and skills required for effective concrete handling.
- **Quality Control Checks:** Implement stringent quality control measures at every stage of concrete production, transportation, and placement as provided in relevant IS Codes.
- **Standard Procedures:** Follow IS standards and site-specific best practices consistently to avoid deviations that can compromise quality.
- **Preventive Measures:** Address potential challenges such as environmental impacts, segregation, and curing inadequacies proactively to mitigate risks. By integrating these practices into daily operations, construction teams can deliver projects that meet the highest standards of excellence and safety, ensuring long-term durability and customer satisfaction.

References

1. IS:1199 (Part 1 to 9) - 2018.
2. IS:456-2000 Code of Practice for Plain and Reinforced Concrete.
3. IS:516 (Part 1 & 3) - 2018.
4. IS:4926-2003 Code of Practice for Ready-Mixed Concrete.
5. ACI-318 Building Code Requirements for Reinforced Concrete.
6. Concrete Technology – Theory and Practice by Prof. M. S. Shetty & A. K. Jain (8th edition), published by S. Chand & Co., Delhi.
7. Ready Mixed Concrete Manufacturers Association (RMCMA) Bulletin No. 5 on "Cracks in Concrete – Causes and Preventive Measures".
8. RMCMA Bulletin No. 6 "Testing of Fresh and Hardened Concrete".
9. IS 7320: Specification for Concrete Vibrators.

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