QA/QC Systems of Readymix Concrete

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- QC :The operational Techniques or a system of maintaining standards by reviewing ,checking, inspecting and Testing
- Quality Assurance(QA)
- The planned and systematic actions and implementation necessary to provide adequate confidence that work will satisfy quality requirements.

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- While many would like to think that quality in construction started in the recent past (1970's and 80's), in reality, our current quality processes and approaches are the culmination of several thousands of years of development and implementation. In fact, back in 700 BC, China had a comprehensive set of standards, inspections, and training to provide high quality parts repeatability.

- 100 AD – the use of concrete to create huge vaults and domes

- 500 AD – Romans were manufacturing bricks for use in construction. This included the use of brick stamps and contracts to trace responsibility.

- Throughout history, the Romans utilized a building yard approach to organizing construction into trades that sequenced work from one to the other – e.g., first the wall frame, then plaster, and finally whitewash.

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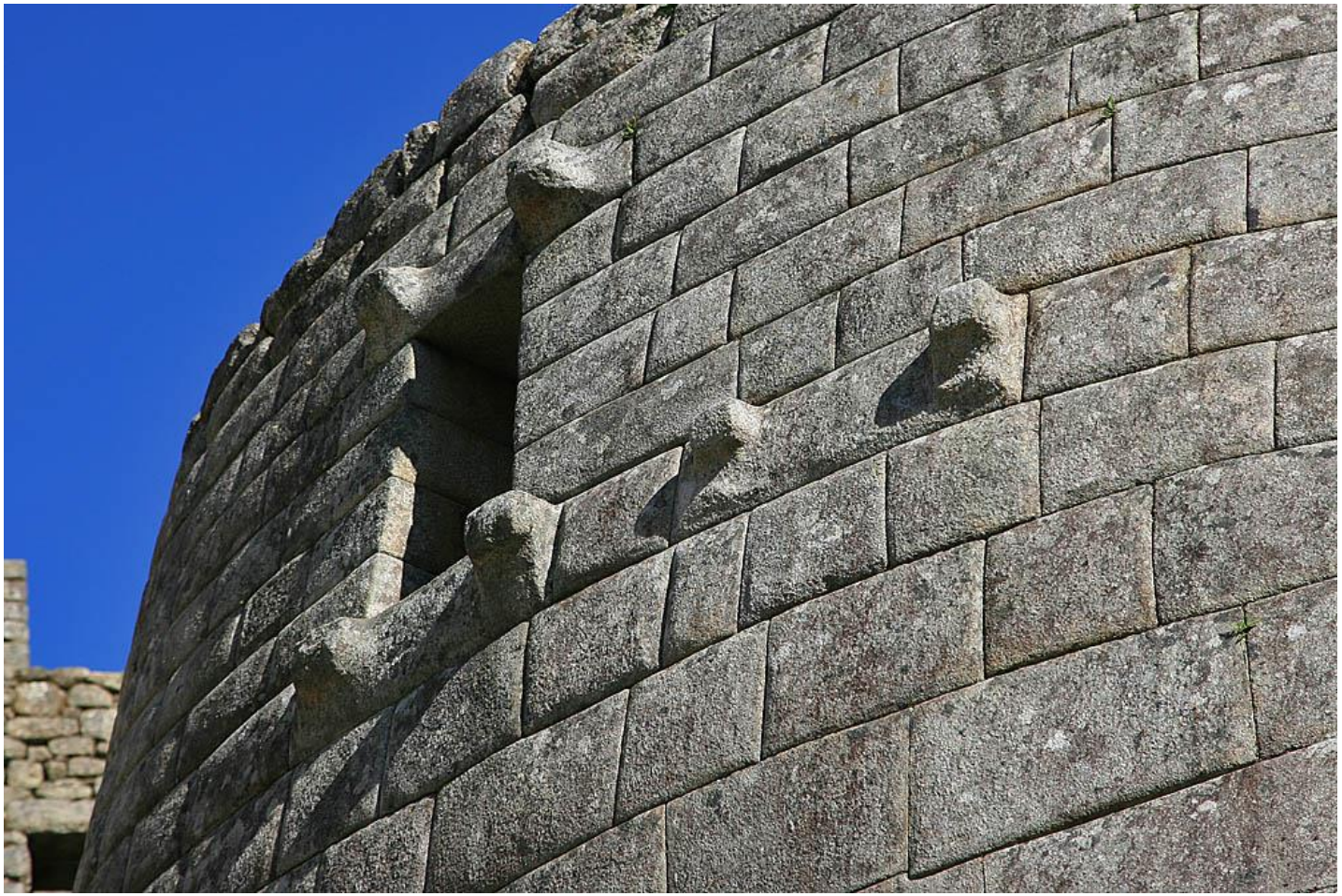
Temple of Sun, Machu Pichu ,Peru



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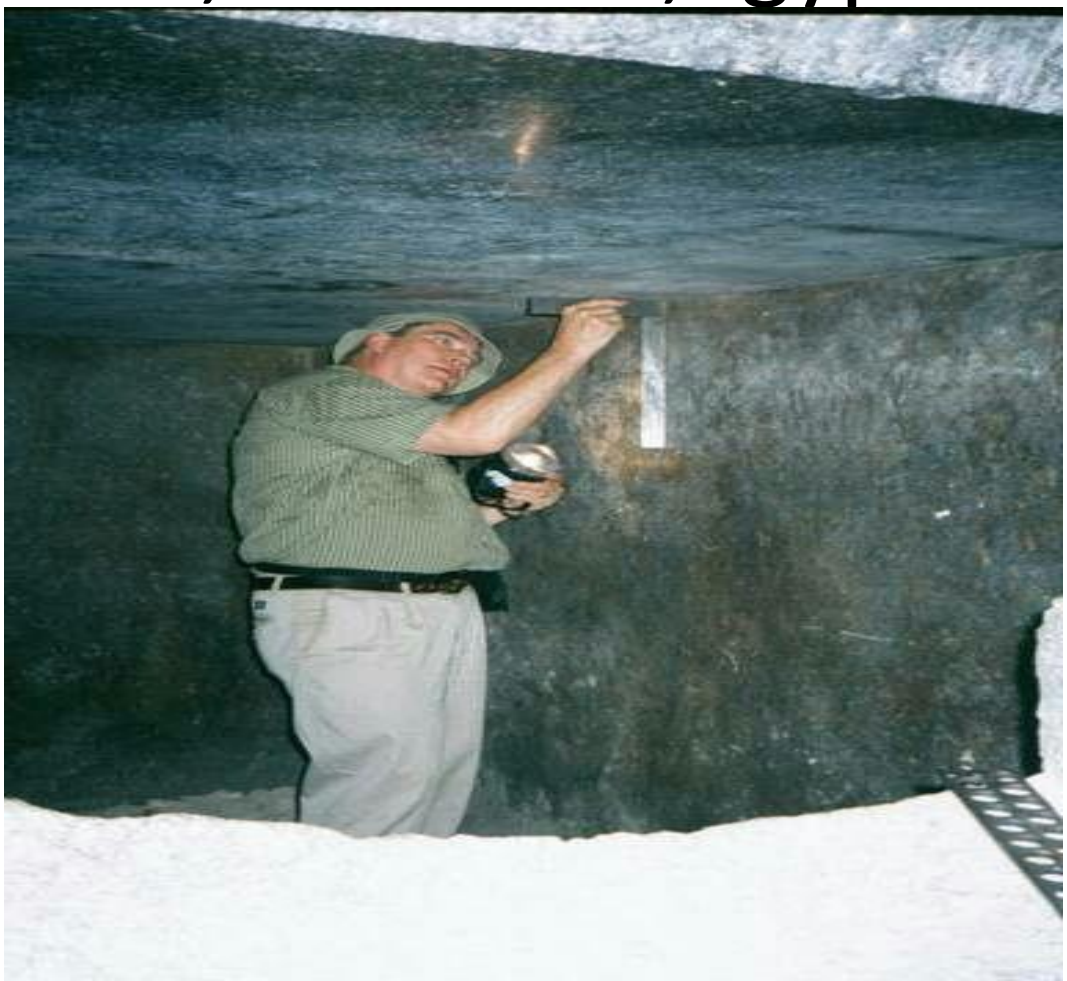
Smooth as glass,stone boxes ,SAQQARA,Egypt



QMS

- sampling and testing of concrete and concrete materials; plant and field control of concrete production; personnel training; user education efforts; evaluation and procurement of new equipment and tools to improve quality; concrete mixture optimization; various promotional activities; research and development testing; specification review; evaluation of concrete performance; and failure analysis and prevention

Readymix Concrete

- Forward Control
- Immediate Control
- Retrospective Control

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Ref :IS 4926

- 1. Control of Purchased Material Quality
- Visual checks……acceptance/rejection
- Sampling
- Testing
- Certification from Suppliers
- Information from Suppliers
- **Recognizing suppliers as partners and a valuable, integral part of readymix business**


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Purchase basis

- availability;
- product quality;
- long term relationships;
- delivery;
- material costs;
- freight costs;
- quality control; and support.

- 2. Control of Material Storage

- PREVENTION OF CONTAMINATION
- DRAINANGE OF AGGREGATES

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- Tracability of materials from Reciept to finished goods

- 3.Mix Design and Mix Design Modification
- Data
- Trials
- Understanding Customer requirements:
- Intended use of the concrete Method of placement (Before submitting mix)
- Offer to customers
- Validation of mix designs
- Arrangement of mix designs

- 4.Plant Maintainance

- 5. Transfer and Weighing equipment
- A. Controlled flow
- B.Calibrated weigh scales
- C. Calibration and Scale check to be done as per frequency
- D. calibrated admixture dispensers*****

- 6. plant mixers and truck mixers
- Blade condition
- Mixer power
- Maintainance
- Check for concrete build-up, blade wear.

Immediate control

- 7. Production control
- A. Weighing(correct reading of batch data and accurate weighing)
- B.Visual observation of concrete during sampling and Testing of fresh concrete to assses uniformity,cohesion,workability and making adjustments to water content
- C.corrections related to moisture

- 8. Product Control
- A.Sampling concrete at plant to be done randomly
- B. Measuring and recording slump
- C. Measuring Temperature at plant
- D. Keeping some sample for checking slump retention

Retrospective Control

- 9. Strength Monitoring
- A. Sampling at Site
- B. Remixing and casting as per STANDARD
- C. protecting cubes in fresh state till transfer to lab
- D. Curing at right Temperature
- E. Crushing cubes and recording


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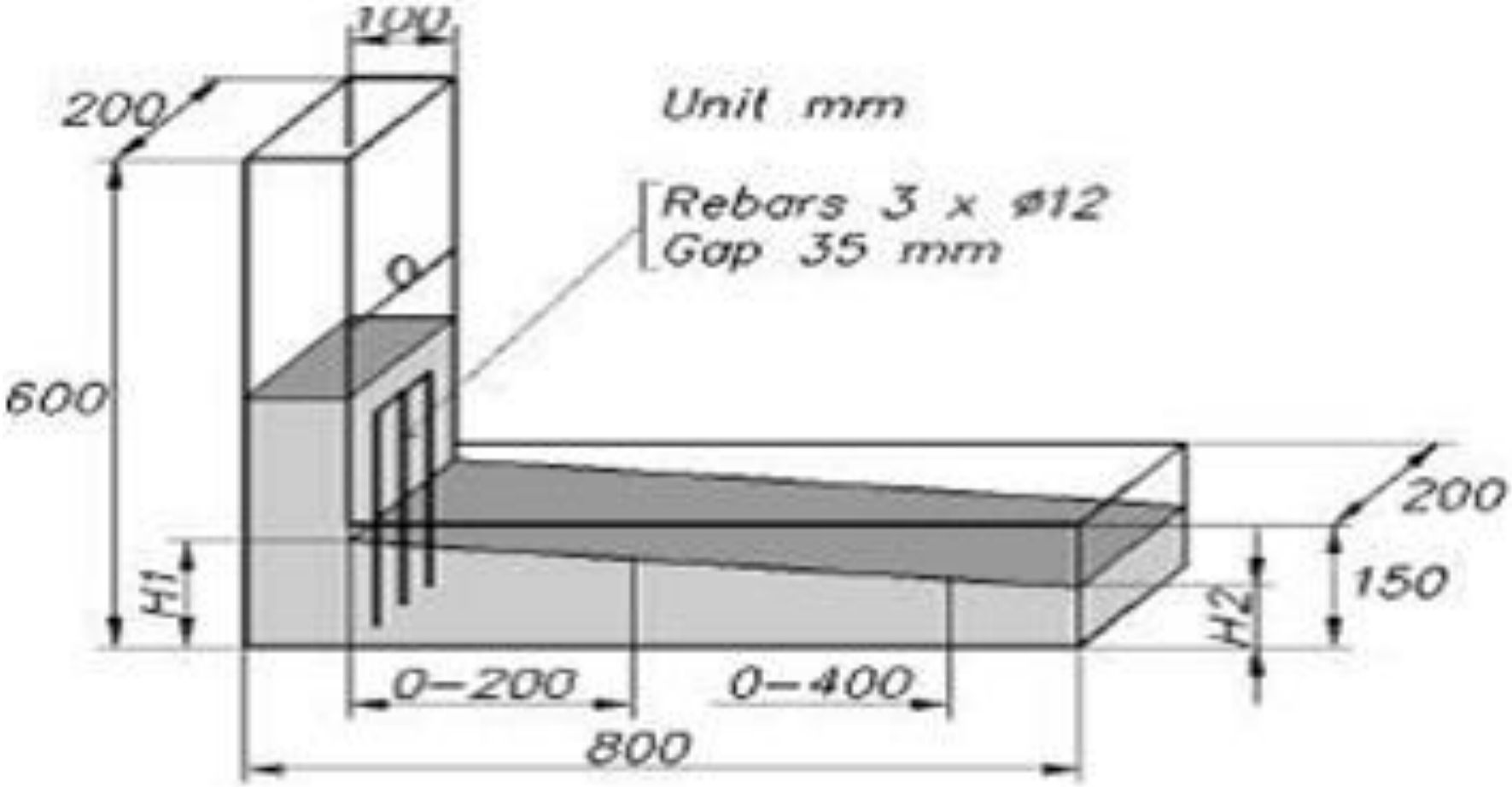

Fig.3. L-box test

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Sampling of concrete:

- As per IS 4926:2003
- Annex C
- Page 11
- Clause 6.1

ANNEX C

(*Clause* 6.1)

SAMPLING OF CONCRETE

After the truck-mixer has re-mixed its delivery on site allow at least the first one-third of a m^3 of concrete to be discharged prior to taking any samples. Take at least 4 incremental samples from the remainder of the load avoiding sampling the last cubic metre of concrete. Thoroughly re-mix this composite sample either on a mixing tray or in the sampling bucket and proceed with the required testing.

Let very first concrete go
Take a scoopful from part 1
Take a scoopful from part 2
Take a scoopful from part 3
Take a scoopful from part 4
Let the last concrete go

SAMPLING

BS 1881: Part 101-Also the recommended sampling method in the forthcoming revision of Indian Standard Specification for ready mixed concrete (Second Revision of IS: 4926)

The standard method

To ensure it is representative of the whole load, a standard sample consists of scoopfuls taken from four different parts of the load and collected in buckets.

Sample as the load is discharged.

Scoopfuls must be taken through the moving stream, sampling the whole width and depth - not just the top part.

Complete a *Sampling Certificate* and record which sampling method was used.

Take six scoopfuls after the first 0.3 m^3 has been discharged
Let the first 0.3 m^3 go
Take six scoopfuls from the next 0.3 m^3

BS 1881: Part 102

The alternative method

For an early check on the workability of concrete delivered in a truckmixer, this alternative method of sampling for the slump test may be used.

Additional tolerances will be applicable for concrete sampled by this alternative method.

Sample as the load is discharged.

Scoopfuls must be taken through the moving stream, sampling the whole width and depth - not just the top part.

SLUMP RANGE

- SLUMP LESS;
- ADD CHEMICAL ADMIXTURE ON SITE
- As per ACI 212.4 R, IS4926

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SLUMP MORE THAN SPEC

- MORE WATER? (Higher w/c, lesser strength?)
- Increase in coarser materials?
- Increase in chemical admixture?
- Wrong batching? (may be lesser ingredients?
- A different cement or same cement brand with different properties/chemical composition?
- Check before accepting ,check all details
- May insist RMC to certify the batch?

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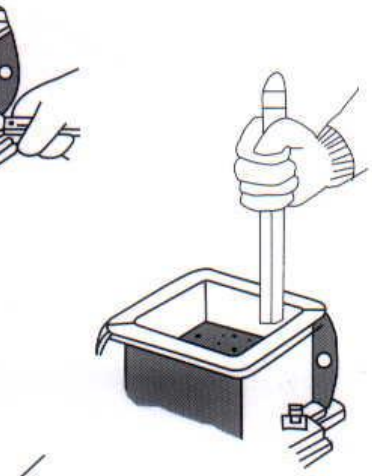
MAKING CUBES IS: 516-1959

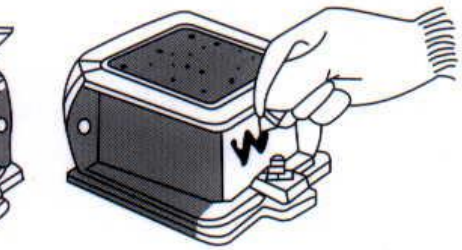
Sample the concrete in the standard manner.

Always clean and dry the equipment after use. Lightly re-oil the cube moulds with release oil.



STEP ONE

- Check that the moulds are clean and lightly oiled with all bolts tightened so that there will be no leakage
- Ensure that the angle between adjacent internal faces and between internal faces and top and bottom planes of the mould shall be $90^0 \pm 0.5^0$
- Thoroughly remix the sample shovelling into a heap.



STEP TWO

- Fill the mould with concrete in 50 mm layers.
- Using the tamping bar, compact the concrete with **not less than:**
  25 tamps for each of the two layers in a 100 mm mould.
  35 tamps for each of the three layers in 150 mm mould.
  For very high workability concrete you may not need minimum number of tamps.

STEP THREE

- Remove surplus concrete and smooth over with a float
- Wipe clean the mould edges
- Number the moulds for identification and record details

STEP FOUR

- Cover each mould with a damp cloth and plastic sheet
- Store at a place free from vibration and a temperature of $27^0C \pm 2^0C$
- Protect the cube moulds at all times from high and low temperatures and drying winds
- Complete the *Sampling and cube making certificates*

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- YIELD CHECK

KEY ASPECTS OF SAMPLING, CUBE MAKING, CURING AND TESTING

- REPRESENTATIVE SAMPLE FROM TRUCK MIXER
- REMIXING OF SAMPLE
- STANDARD CUBE MOULDS ASSEMBLED AND OILED
- FULL COMPACTION OF EACH LAYER
- MAINTAINING CUBE MOIST OVERNIGHT
- CURING CUBES UNDER STANDARD CONDITIONS
- OBSERVATION OF CUBE FAULTS,
- ACCURATE MEASUREMENT OF DIMENSION & WEIGHT
- ACCURATE MEASUREMENT OF DENSITY & STRENGTH

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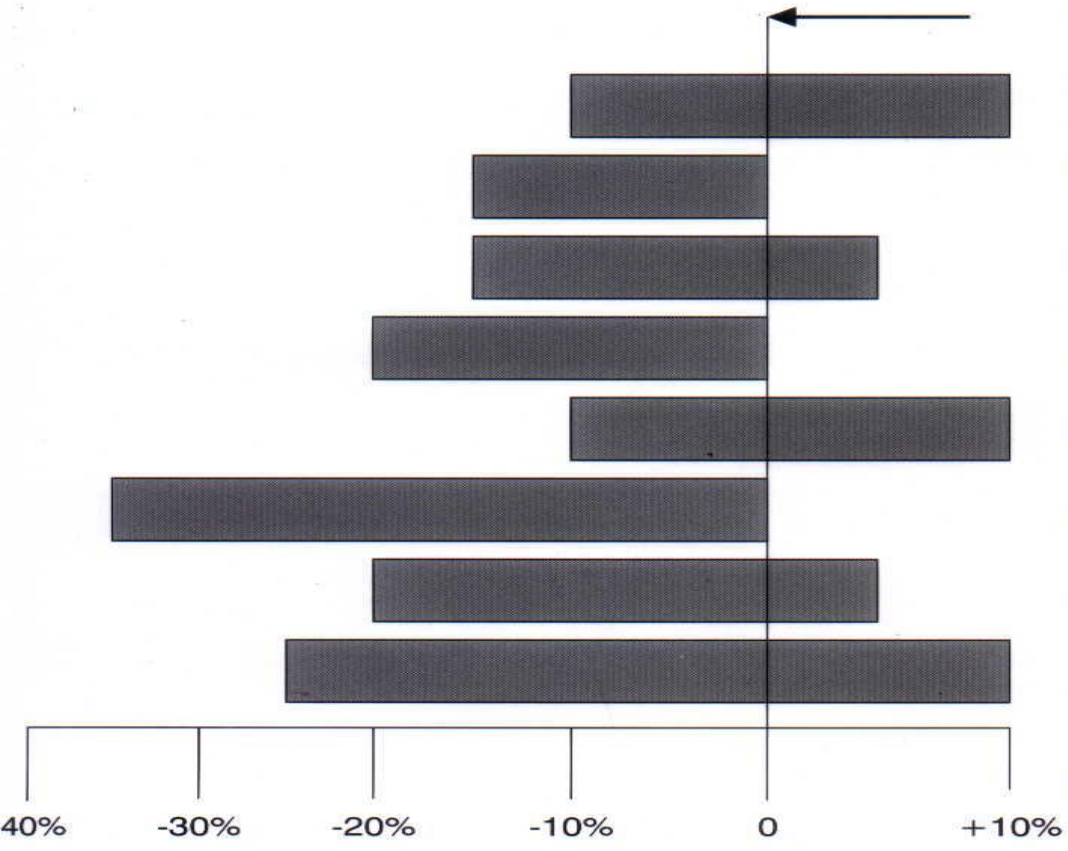
RANGE OF EFFECTS OF DEVIATION FROM STANDARDS ON ACTUAL CUBE STRENGTH*



*Manual of ready mixed concrete (J.D. Dewar & R. Anderson)

Curing Room with Tanks

Temperature controlled

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INFORMATION TO BE PROVIDED BY PRODUCER

- To fulfill the requirements of IS 4926-2003, when requested the producer has to furnish the following information
- A)Nature & Source of each constituent.
- b) Source of supply of cement.
- c) Proposed proportions or quantities of each.
- d) Information on generic type(s) of main constituents of admixtures, whether it is dosage free, whether the dosage causes air entrainment, compatibility when more than one admixture is used and also initial, final setting time of concrete when used at proposed dosage (tested as per IS8142).

- **DELIVERY TICKET**
- **Should be as per IS 4926 ANNEXURE G**

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FULL CHECK LIST

- MATERIALS AS PER IS 456-2000.
- MATERIALS TESTING AS PER IS 4926 OR AS PER WELL DEFINED COMPANY QUALITY MANUAL.
- STEPS AT BATCH PLANT TO PREVENT CONTAMINATION.
- CALIBRATION OF BATCH PLANT.
- MAINTAINANCE OF BATCH PLANT, TRUCKS, WEIGH SCALES,
- CALIBRATION OF LAB EQUIPMENTS
- CHECKS @BATCH PLANT.
- CHECKS AT SITE
- FORWARD, INTERMEDIATE & RETROSPECTIVE CONTROLS.
- DELIVERY TICKETS, INFORMATION TO PURCHASER AS PER IS 4926.

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Statistical Quality Control

Mean

Standard Deviation

Coefficient of Variation

Cusum method

Acceptance Criteria

Table 11 Characteristic Compressive Strength Compliance Requirement

(Clauses 16.1 and 16.3)

Specified Grade	Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm²	Individual Test Results in N/mm²
(1)	(2)	(3)
M 15	≥ f_{ck} + 0.825 × established standard deviation (rounded off to nearest 0.5 N/mm²) or f_{ck} + 3 N/mm², whichever is greater	≥ f_{ck} − 3 N/mm²
M 20 or above	≥ f_{ck} + 0.825 × established standard deviation (rounded off to nearest 0.5 N/mm²) or f_{ck} + 4 N/mm², whichever is greater	≥ f_{ck} − 4 N/mm²

NOTE—In the absence of established value of standard deviation, the values given in Table 8 may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

- Designed Mixes
- A concrete producer will have a range of mixes which are obtained by trials ,also can be based on previous data on similar ingredients

we need to evaluate:

- Setting characteristics Material compatibility evaluation Workability; Placeability; Strength; Uniformity; Durability;

- Prescribed Mixes

- Periodic and systematic checks shall be made to ensure that the cementitious material contents of prescribed mixes comply with their mix description

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- Stock Control of Materials

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- Complaints and Feed back
- Complaints
- Workability related
- Strength related
- Service related
- Any other……?

- Identify your customers (external and internal) and then define how you measure their level of satisfaction with your products and services. Although many of your customer requirements are documented in the project specifications, many of their needs and inherent requirements are not specifically stated. How do you evaluate your customers' perceptions of your organization or their level of satisfaction with your performance on a particular project? How do you monitor your proposals, quotations, purchase orders and contracts to determine that you are addressing the requirements and needs of the customer? .

- It is important to promptly act on even the smallest of complaints. Delays or inaction may result in further customer dissatisfaction and ultimately in costly litigation

- Training
- Competency gap
- Enhancing abilities
- To a level to meet Customer Satisfaction

- QUALITY COUNCIL OF INDIA and RMCMA ,have made comprehensive check list to Audit Readymix concrete plants for capability of Production.
- QCI certificate is highly valued by Specifiers all over India.

QA/QC systems

- Preventative – the primary intent of all quality programs is to get ahead of and avoid quality issues – ultimately, by doing work right the first time, we eliminate rework, avoid loss productivity of all having to resolve issues, and avoiding generation of waste.

- Predictive – establishing and using metrics within QA/QC systems to understand how the systems are working is essential. These analyses and use of metrics need to be used to drive the future direction of the quality program and be predictive in nature, typically focusing efforts around what is the highest risk, at project, company and industry level.

- Continuous Measurable Improvement – QA/QC systems are not stagnant and must have a continuous improvement component that is measurable, typically at the individual, project and program levels.
- A key component of continuous improvement is the creation and use of knowledge to continually improve what and how things are done.

- Collaborative – to achieve quality requires close collaboration among all project participants in order to clearly define what quality is, prevent quality issues, and hold each other accountable to continuously improve approaches and deliverables.

- Individual – for any QA/QC systems to be successful, it is critical that the entire quality program is focused on getting the right information/tools, to the right person, at the right time, so they can do their job right the first time. Bottom line is that the quality we get is determined by each individual of the company.

What Contributes to Quality?

- Planning
- Skill
- Schedule
- Resources
- Alignment/Behaviour
- Management Commitment

- Thank YOU
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