CEL 774
IIT DELHI
Construction pRACTICES

(Lecture 1-3)

Concrete: Production

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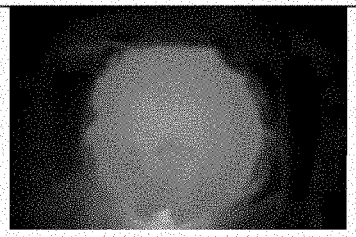
General Outline

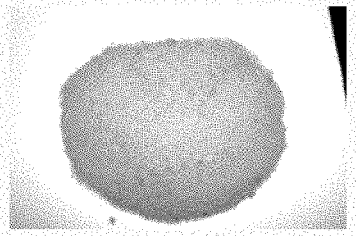
- **Concrete Production.**
  - **Production Process**
  - **Batching.**
  - **Mixing.**

What is CONCRETE?

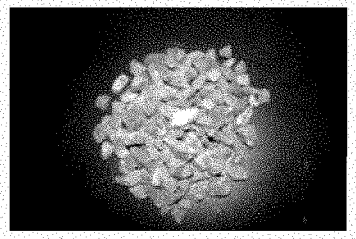
- ***Ordinarily concrete is made by mixing an inorganic material known as cement with water together with natural sand or stone dusts and natural stones which may be uncrushed or crushed.***



Cement



Sand/ Fine Aggregate

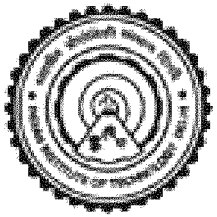


Stone / Coarse Agg.

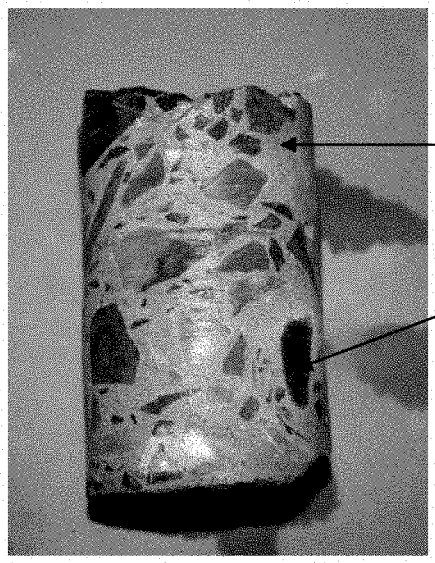
CEMENT

– *Most commonly used cement is called Portland Cement patented in 1824 in England, when mixed with water, hardens, hence hydraulic cement .*

❖ *Basic raw materials used in the manufacture of cement are calcium carbonate found in lime Stone or chalk, and silica, alumina and iron oxide found in clay or shale.*



AGGREGATES



- *Aggregates forms the skeleton matrix*
- *60-75% by volume.*
- *25-40% Paste*
- *1-2% Voids.*

- ***Aggregate shall be inert and strong.***

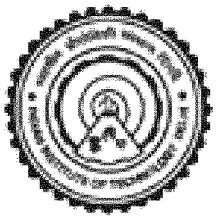
ADMIXTURES

- *Chemical Admixture: Used for specific Property/performance enhancement.*
- *Mineral Admixture: Used for improvement of long term strength and durability performance.*
- ***Using above admixtures together, high Strength and high performance concrete Materials can be designed.***

ADVANTAGES AND DISADVANTAGES OF CONCRETE

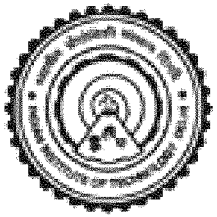
- *Lower life cycle cost*
- *Mould-ability*
- *Robustness.*
- *Can be designed for desired property*
- *Low tensile strength.*
- *Lower ductility (brittle)*

➢ ***Concrete is most popular construction material.***

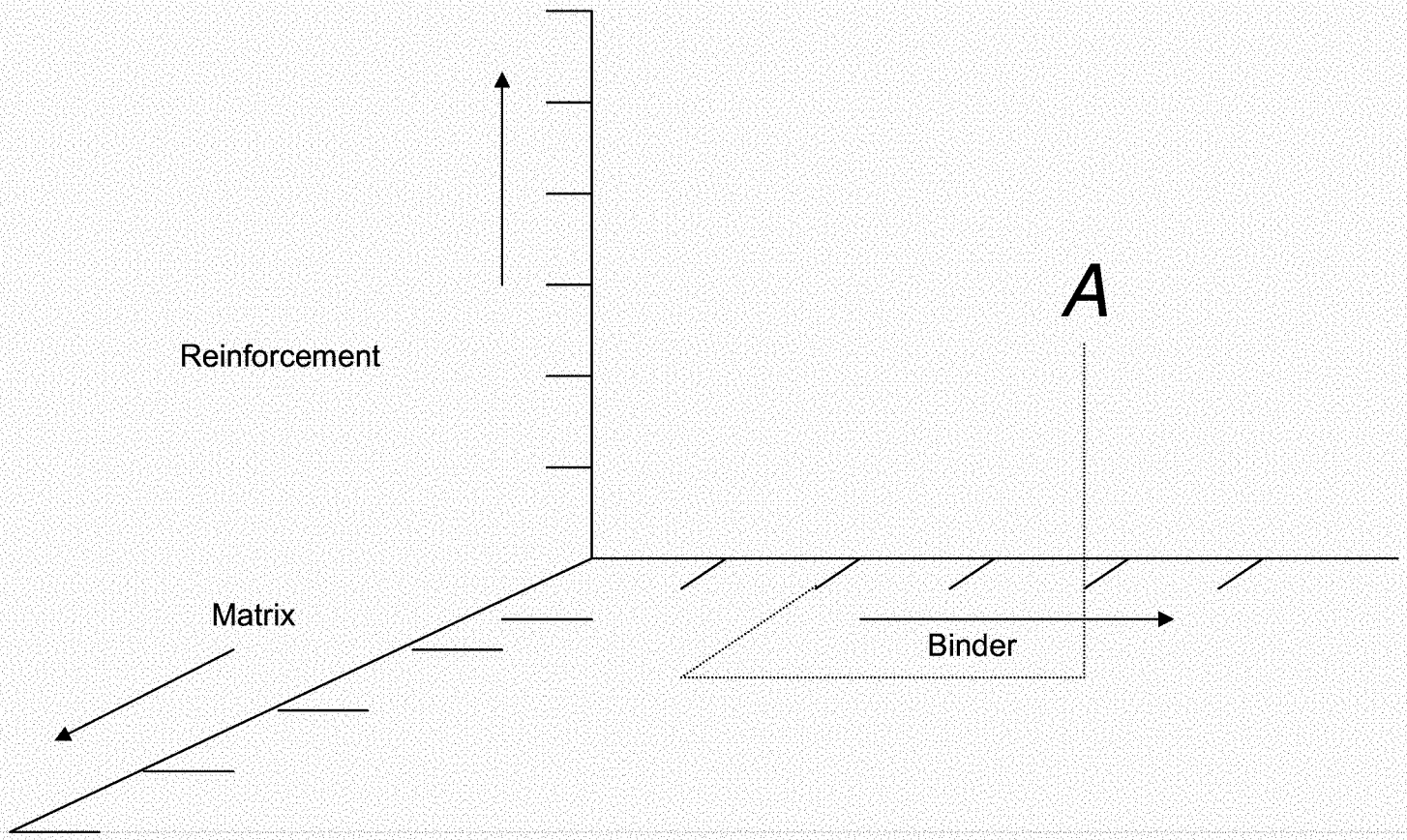


CONCRETE & COMPOSITES

- *Normal strength Concrete*
- *High strength/performance concrete*
- *Ultra high strength concrete*
- *Fiber Reinforced Concrete.*
- *Densified with small particle (DSP)*
- *Macro Defect Free (MDF) Matrix*
- *Reactive Powder Concrete (RPC)*
- *Polymer Concrete (PC)*
- *Polymer cement concrete*



CONCRETE COMPOSITES



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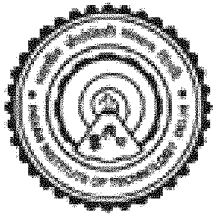
DESIGNATION OF NORMAL STRENGTH CONCRETE

– Concrete is designated through 28 day Standard cube compressive strength.

❖ In Indian Standard Code of practice (IS 456) a concrete is designated by its characteristic cube compressive strength at 28 days, the cube being cast, cured and tested in a standard manner.

❑ Concrete is designated as M25 has a 28 day Characteristic standard cube strength of 25 MPa.



PERFORMANCE OF CONCRETE

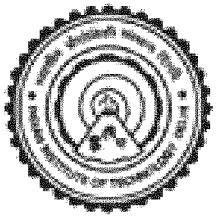
- ***Normal*** *strength concrete:* ***≤ 60MPa***
- ***High*** *strength concrete:* ***60 ≤ f*** $_c$ ***≤ 120MPa.***
- ***Ultra*** *High strength concrete:* ***≥ 120MPa.***

- *Performance at fresh state: Self Compacting*
- *Long term durability performance.*

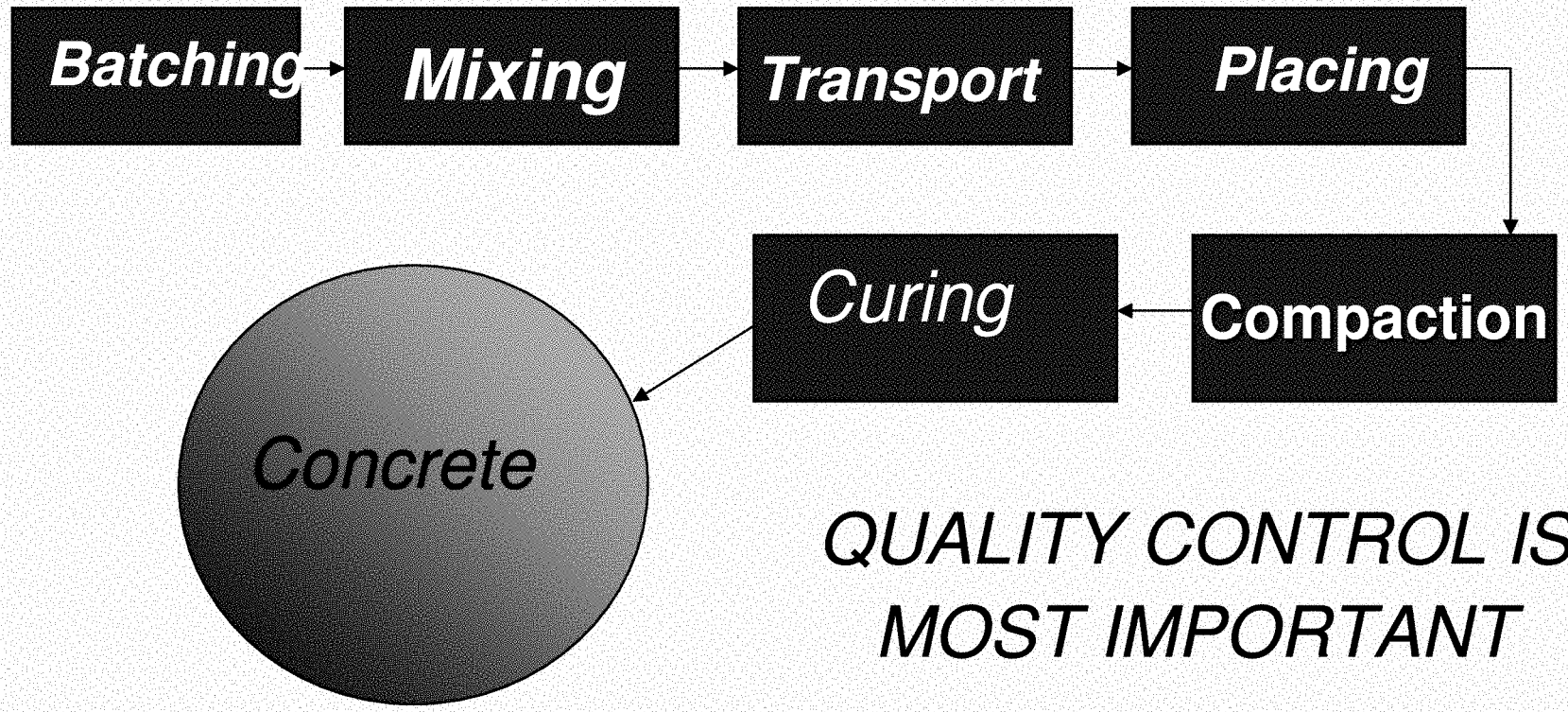
➢ ***Concrete is a versatile construction material.***

SUMMARY

- **Concrete Material.**
  - **Natural aggregates, cement or cementitious and water and also admixtures.**
  - **Concrete composites.**
  - **Concrete is designated by characteristics 28 day cube compressive strength.**
  - **Performance of concrete at fresh, hardening and hardened state.**



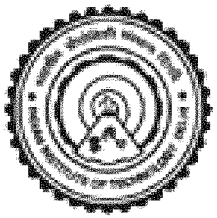
Production Process



QUALITY CONTROL IS MOST IMPORTANT

Batching

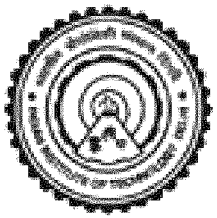
- ***Batching*** *is the process of measurement of specified quantities of cement, aggregates, water and admixture, i.e., ingredients of concrete in correct proportion.*
- ***Batching Process***
  - *1) Volumetric batching .*
    - *Not desirable except for small non engineered jobs*
  - *2)Weigh Batching (Mass basis, IS456:2000)*



Batching Process

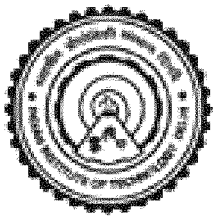
- *Batching by mass (weights) as reproducibility of loose volume is inadequate and is not economical .*

- *Control and storage of materials Aggregate bins for storing aggregate. Silos for storing cement and cementitious materials*



Batching Plant

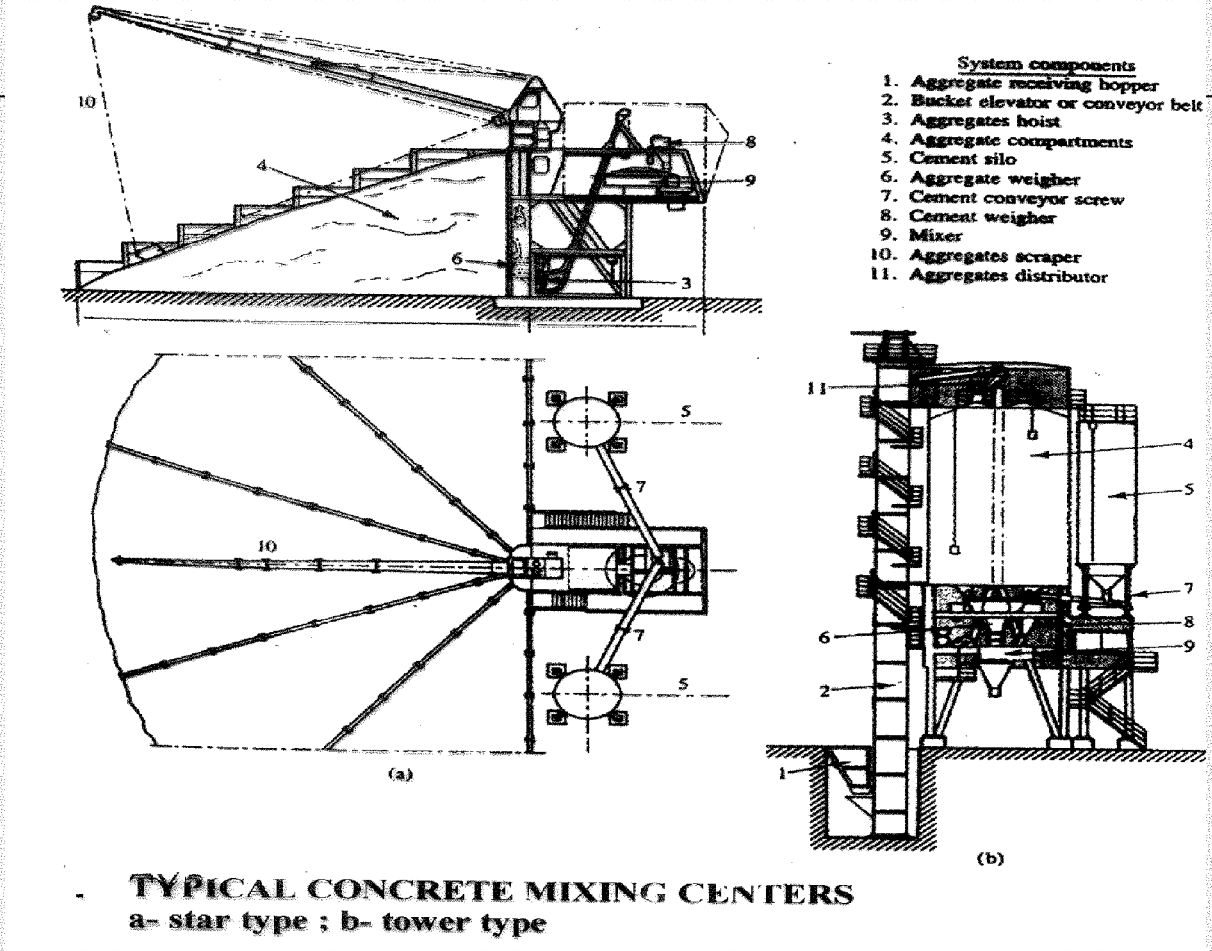
- ***Components of a Batching Plant***
  - *A) Aggregate bins for various types of aggregates.*
  - *B) Feeding mechanisms such as scrappers, conveyors or hoists etc. to transfer aggregate to scales (balances).*
  - *C) Balance and measuring system.*



Batching Plant

- ***Components of a Batching Plant***
  - *–D) Cement silos and a conveyor screw or bucket conveyor .*
  - *– E) The storage tank for water and water measuring system .*
  - *– F) Dispenser for chemical (liquid) admixture.*

Batching Plant



TYPICAL CONCRETE MIXING CENTERS
a- star type ; b- tower type

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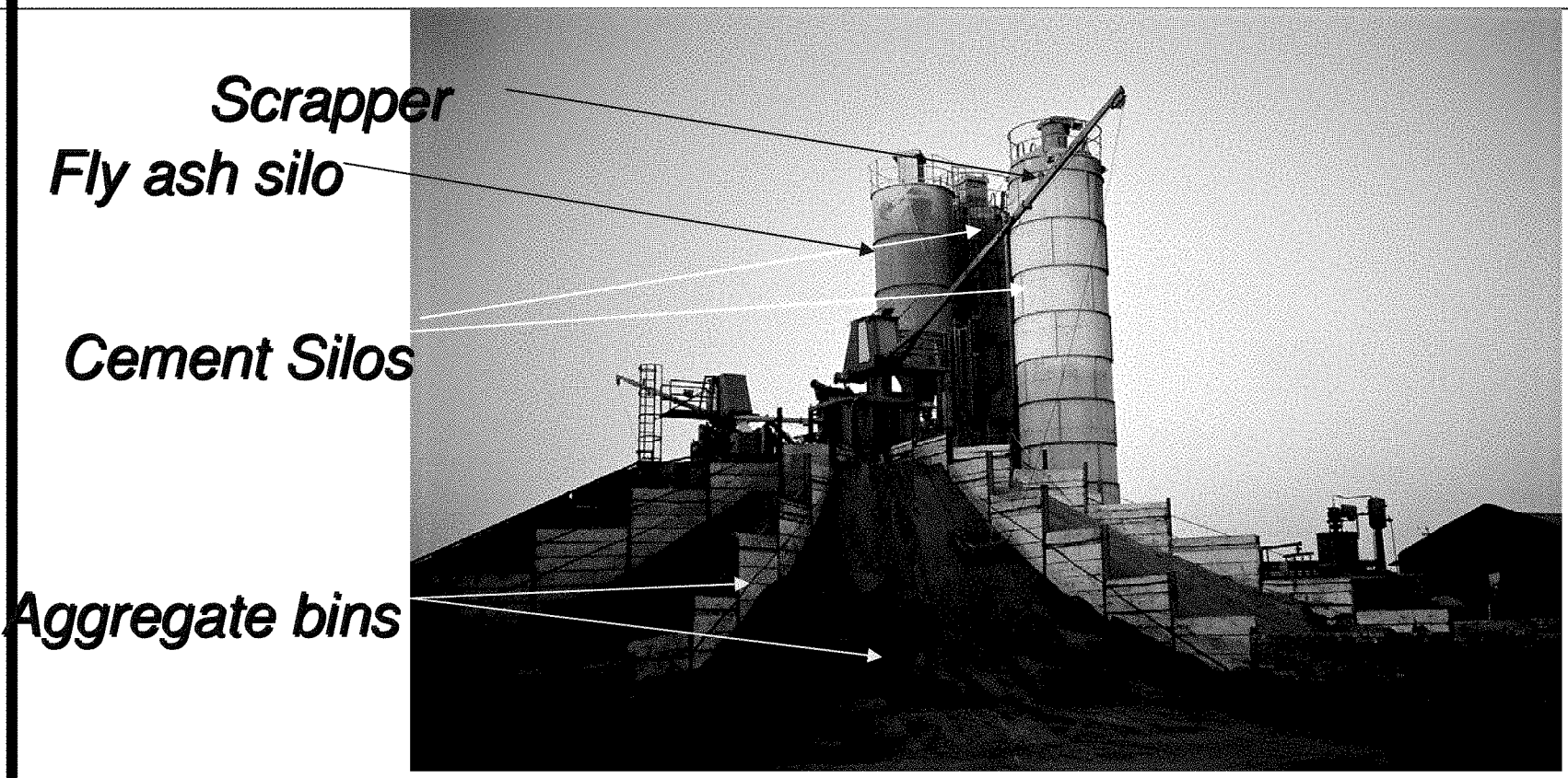
BATCHING PLANT



BATCHING PLANT

Screw Conveyors

Control Room

Mixer

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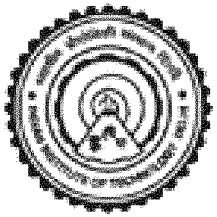
BATCHING

- *Plant Type can be cyclic or continuous.*
- *Plant Type can be automatic or manual*
- *Accuracy:*

  Recommendation of IS 456 is ±2% for the quantity of cement measured and ±3% for the quantity of aggregate, water and admixture being measured.



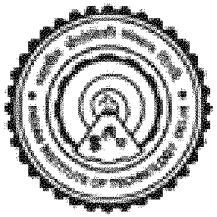
PLANT CAPACITY

– ***Capacity depends on***

- *1) size of the job;*
- *2) required production rate; and*
- *3) required standard of batching performance.*

➢ *Capacity of the material handling system, bin size, batcher size and; mixture size and number controls the capacity*

Q=min(Q1, Q2, Q3, Q4…..)

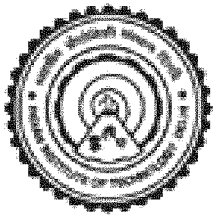


INSTRUMENTATION AND MEASUREMENTS

- *mechanical lever system, load cells etc for measurements of mass.*
- *Controlling the discharge from storage and weigh hoppers is through gates operated by compressed air cylinders.*
- *Presetting of desired batch weights can be done by devices such as punched cards, digit switches or rotating dials and computers.*

INSTRUMENTATION AND MEASUREMENTS

- *Electrical or microwave moisture gauges can be used as aggregate moisture meters .*
- *Water is most commonly measured through flow meters, although in some plants water is also weighed .*
- *With the need of adequate calibration, frequent regulatory routine and specialist's checks of weighing process are required without too much difficulty .*



TOLERANCES
(individual Batch IS 4925)

Ingredient	Batching tolerances (%)
Cement and other cementitious materials	±1
Water (by volume or weight),%	±1
Aggregates, %	±2
Admixture (by volume or weight),%	±3

TOLERANCES (individual Batch)

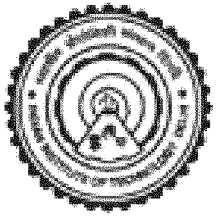
tolerances applies to:

Minimum weight (kg) =

[0.3×scale capacity (kg)] /Weigh tolerance (%)

as in table

- Uniform concrete exhibits less variation.
- Variation depends on variation in proportions
  - e.g., higher **ΔC** and **ΔW**, *the* ***errors in cement & water*** measurements will result in higher variation in strength.
- Proper Batching ensures better quality



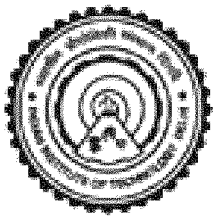
MIXING

- ***Thorough mixing is essential for production of uniform quality concrete.***

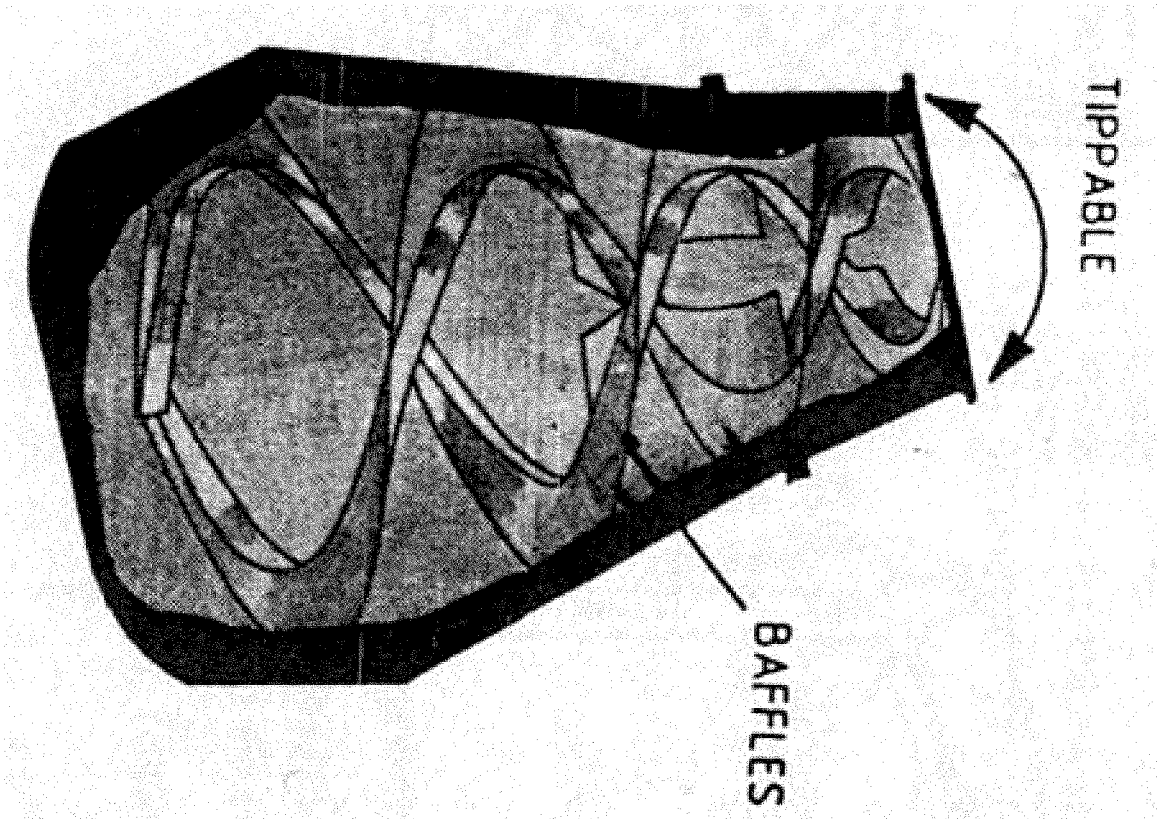
- ***Equipment and method should be capable of effectively mixing concrete material containing largest specified aggregate to produce uniform mixtures of the lowest slump practical for the work.***

MIXING

- *cyclic or batch mixers, and continuous mixers. .*
- *gravity mixers or mixers with forced movements*
  - *They can be tilting or Non-tilting*
- *Counter-flow mixer or open–pan mixers*



TILTING DRUM MIXER



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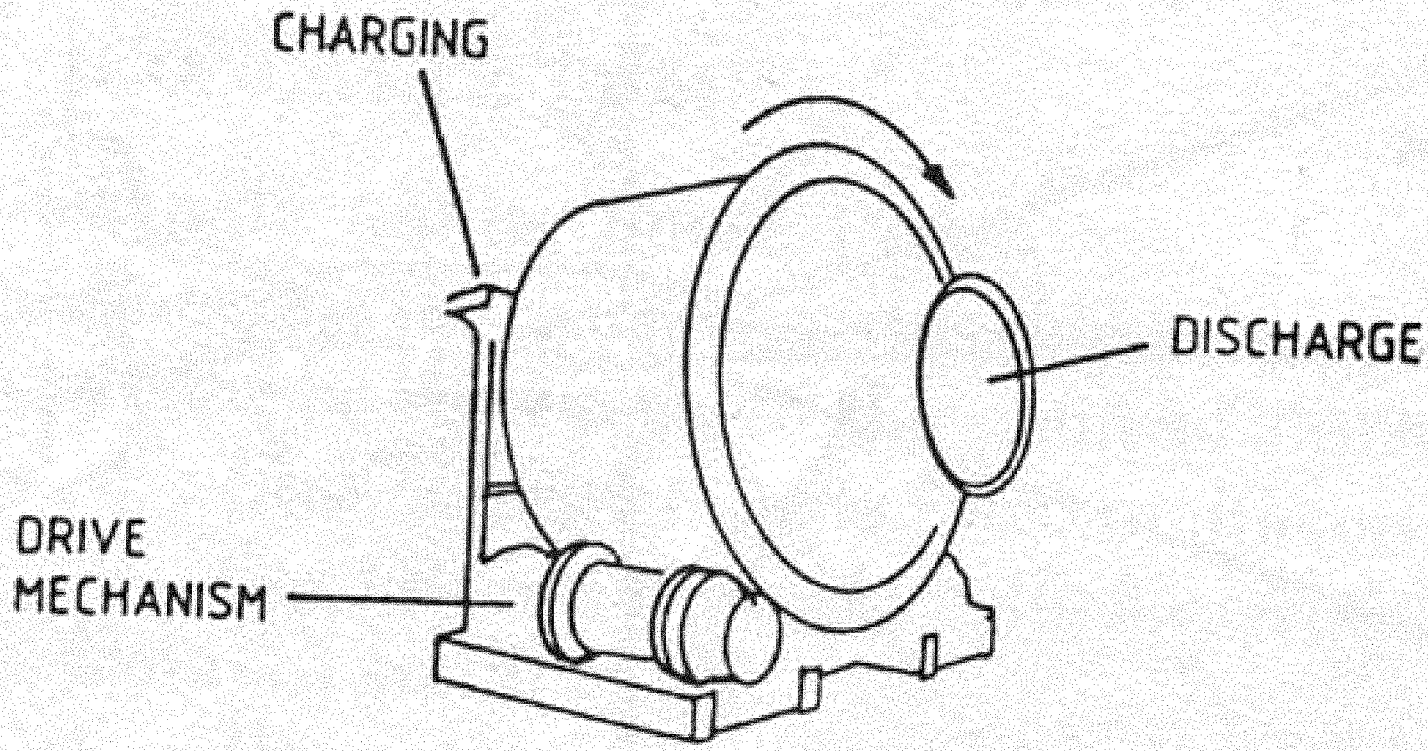
NON-TILTING DRUM MIXER



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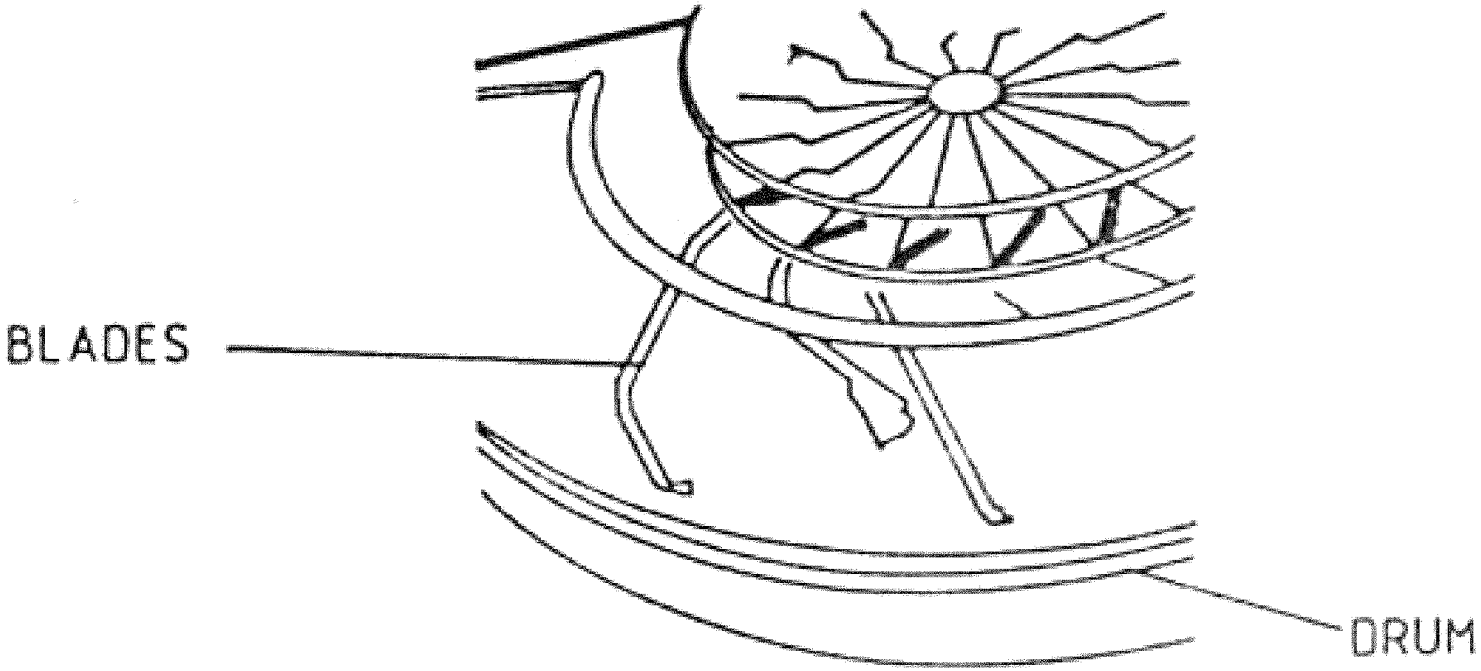
PAN MIXER



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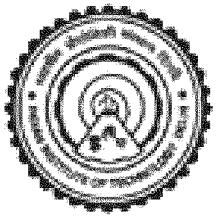
PAN MIXER

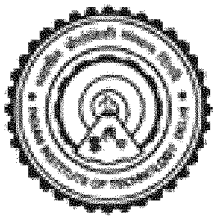
MIXING

- *uniformity tests on samples of fresh concrete collected from the mixer at different stages of its discharge from a given batch. .*
- *Charging: pre-blending and ribboning effect*
- *Mixing Time: 1minute is required for 0.75 m3 capacity mixer and 0.25 minute is required for each additional 0.75 m3 capacity*



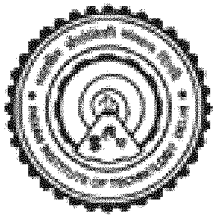
MIXING TIME

- **IS guide lines**
  - *IS 4925-1968 "mixing time for each batch of materials, except the full amount of water, provided that all the mixing water shall be introduced before one-fourth the mixing time elapsed" shall be 1½, 2 and 2½ minutes respectively for mixer capacity up to 2 m3, 3 m3 and 4 m3 respectively. IS 456 : 2000 guidelines specifies a overall minimum mixing time of 2 minutes*

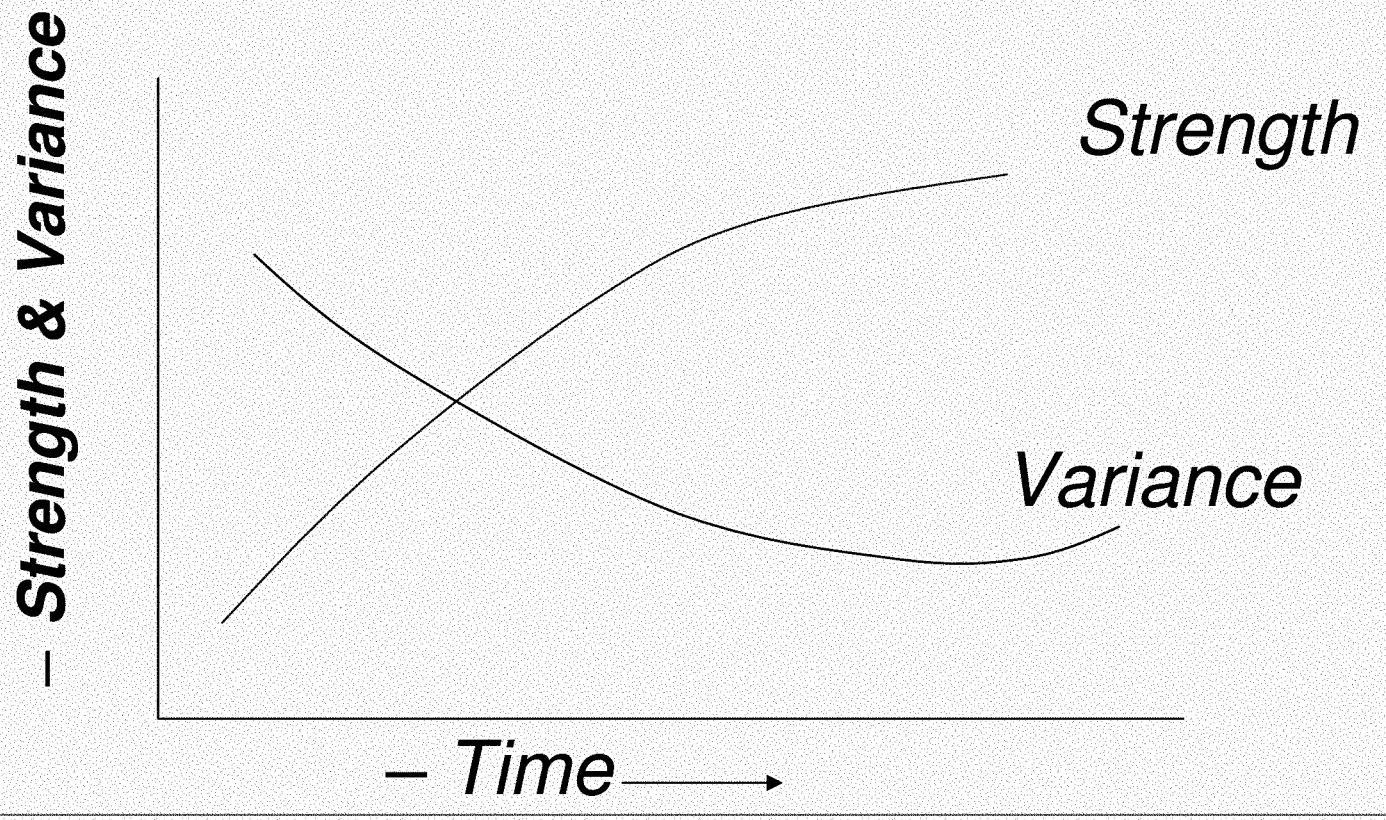


MIXING TIME

- *increasing mixing time may result in more uniform distribution of hydration product resulting in higher compressive strength*
- *prolonging the mixing process too long may not increase the strength proportionally and may result in a decrease in some cases.*
- *over grinding of the material and in some cases may increase the proportion of fines. Quite often excessive mixing leads to segregation in case of leaner concretes.*



MIXING TIME



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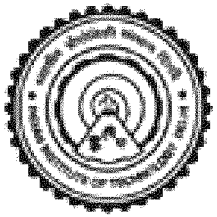
SUMMARY

- *Concrete production process*
- *Batching process and its importance in producing quality concrete*
- *Mixing process for producing uniform quality concrete*



THANK YOU
FOR HEARING