Concrete Production

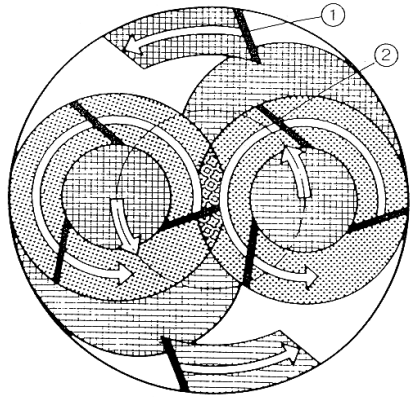
American Concrete Pipe Association

Concrete Production

- ASTM C94 - why?
- Specifications for ready mix most closely align with our product mix and production concepts
- Good starting point for specifications rather than inventing new ones

Redi-mix Requirements

- Consistent Aggregates
- Aggregates Stored Properly
- Accurate Mix Proportions
- Consistently Mixed
- Transported to the forms



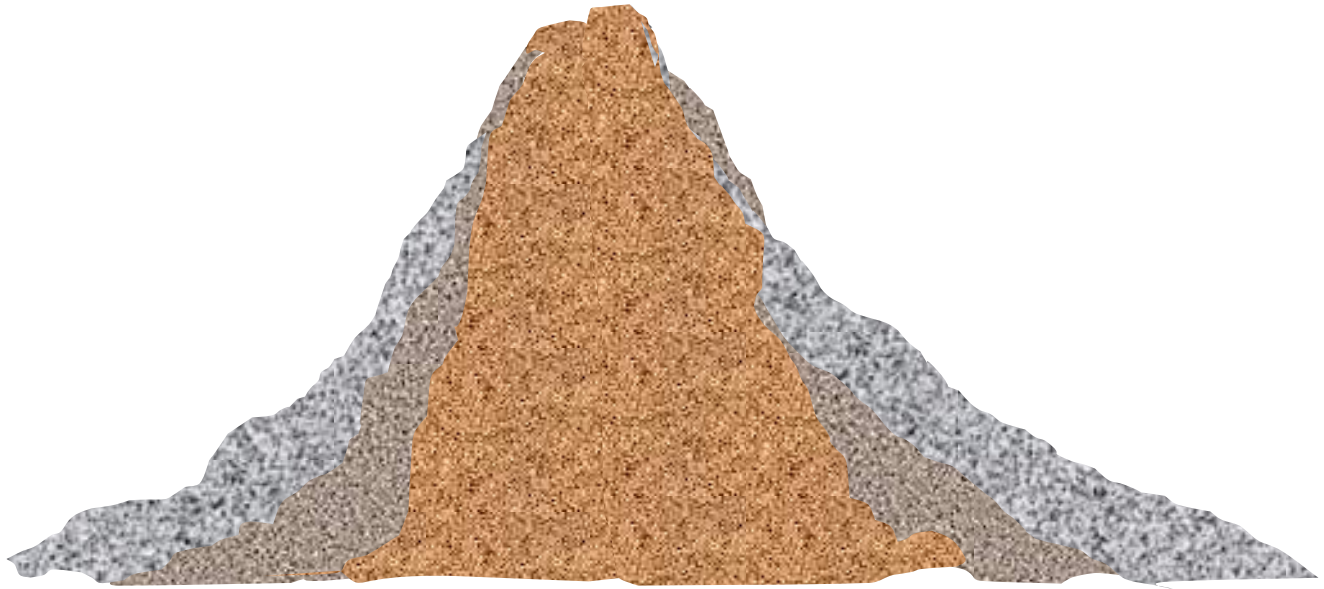
Concrete Production Topics

Material Handling
Batching
Mixing
Transporting

Material Storage And Handling

Proper Aggregate Storage

- Minimize Segregation
  - Do not store in conical piles
  - Store in horizontal layers
- Prevent Contamination
  - Store on slabs or planking
  - Have storage bins separated by walls
- Keep gradations within specified limits
- Reference ACI 304, “Guide for Measuring and Placing Concrete”

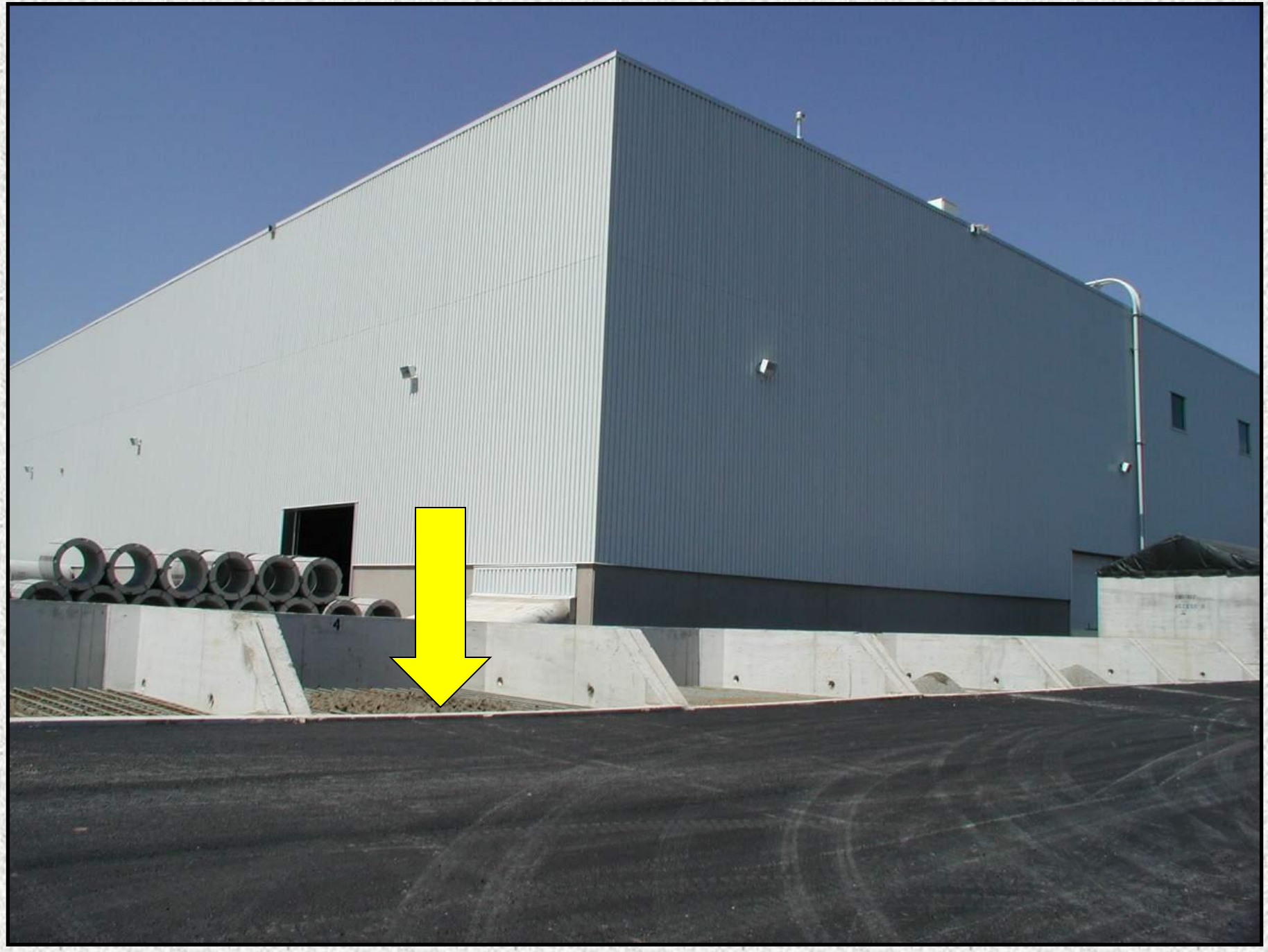


Stockpiles that stack traditionally can segregate, with **coarser material falling to the bottom/outside, and finer material remaining in the center and top.** Degradation can occur if loaders or dozers drive onto the stockpile, or if material is falling from a great height — potentially splitting or crushing the gradated material. Equipment driving on stockpiles can also cause contamination, as it tracks dirt or loose material onto the stockpile.

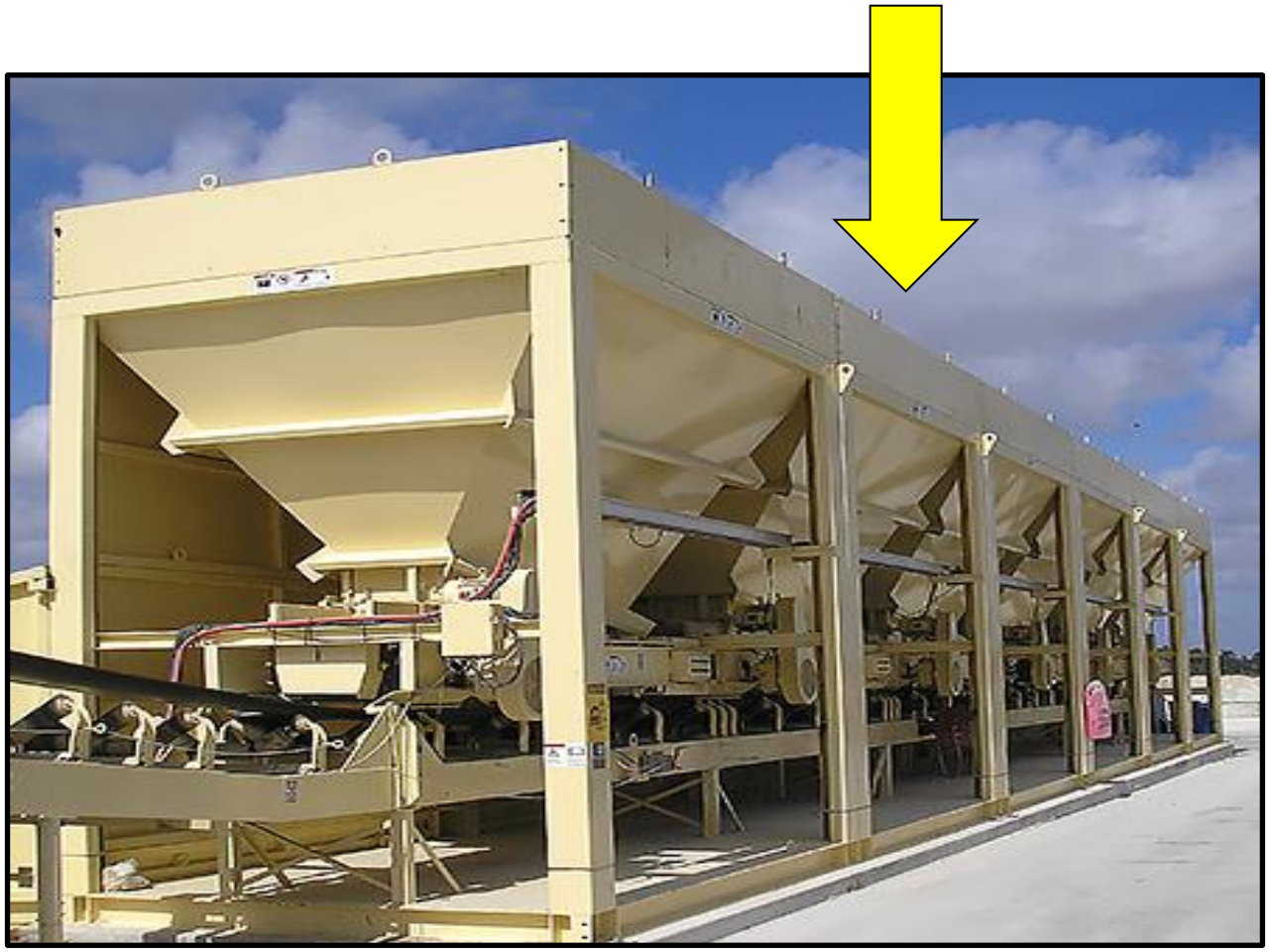

WOW!

Correct loading techniques gathers a blend and does not hurt the pile

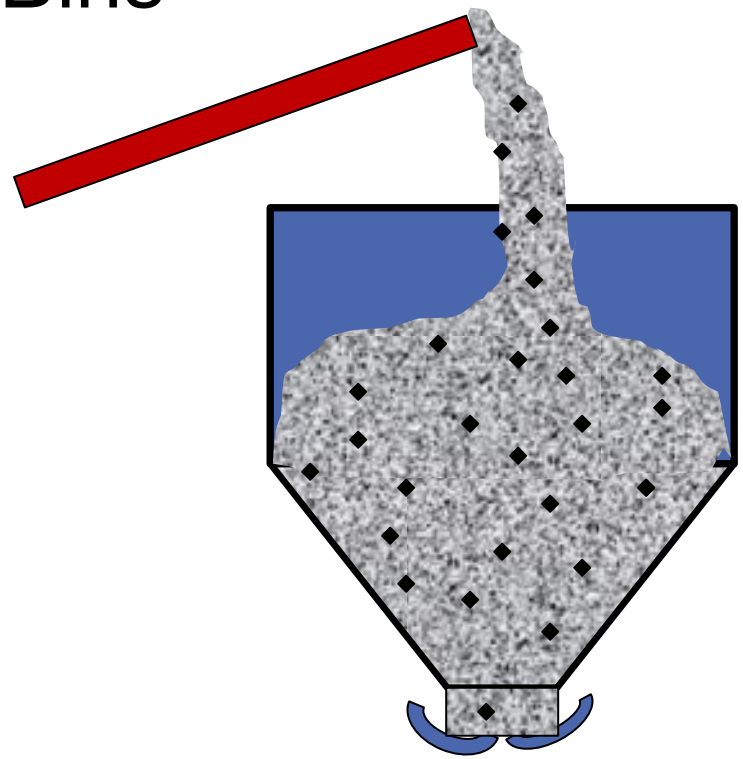

WHITE SAND



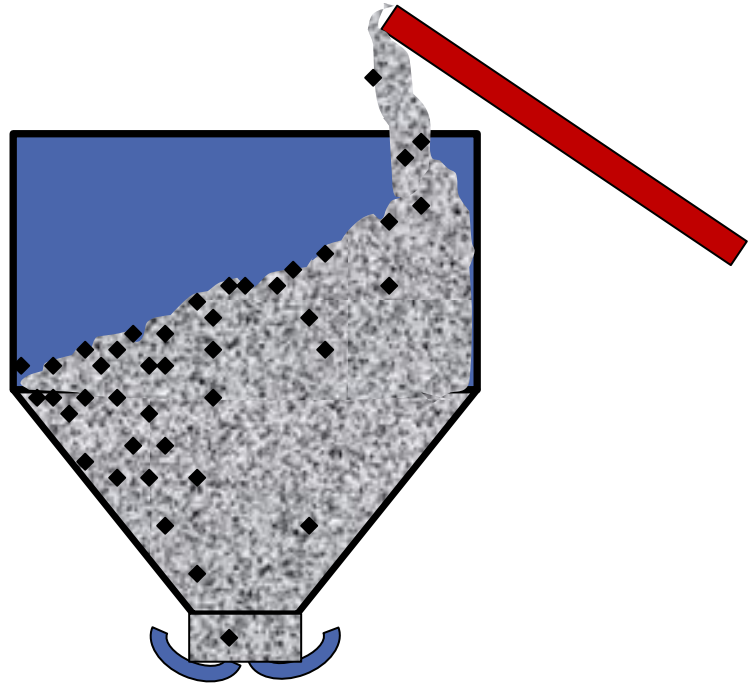
Under the individual grizzlies will be a system similar to this. The storage bins are directly under the truck dump areas and feed into individual weigh hoppers or onto a cumulative weigh belt that leads to the mixer



Filling Aggregate Bins



Correct



Incorrect

Batching

Batching

- Accuracy of weighing
- Compensating for moisture in Aggregates
- Sequencing

Typical Batching Tolerances (C94)

- Cementitious +/- 1%

  (for batches less than 1cy not less than required, up to 4% over)
- Water +/- 1%
- Fine Aggregates +/- 2%
- Coarse Aggregates +/- 2%
- Cum. Aggregates +/- 1%
- Admixes +/- 3%

  (or minimum recommended dosage per 100 weight or which ever is greater)

Accuracy

- Scales must hang free
- Scales (gates or valves) must not leak
- Scales must empty completely after each batch
- Zero on scales should be checked on a regular basis
- Calibrate scales annually

Why Compensate for Moisture in Aggregates?

- Batch Consistency
- Predictable strengths
- Production efficiency

Free Moisture

- The **free moisture** must be accounted for when batching our concrete to help control mix costs and to improve its quality and consistency

Free Moisture Example

- Consider the amount of water in **1,854** pounds of sand
  (which is a typical amount of sand for a yard of pipe machine concrete)
  that has **4%** total moisture in it and has an absorption of **1%**
- This gives us free moisture of **3%** (4%-1%)

Free Moisture Example

- At 3% moisture:
- The 1,854 pounds of sand that we weighed up is 1800 pounds of SSD sand and 54 pounds of water
- Fifty-four pounds of water is 6 ½ gallons (54pounds/8.33 pounds per gallon) of water
- We are 54 pounds short of sand and we have 54 extra pounds of water
- If we do not compensate properly for this difference, it will significantly affect the cost and quality of the concrete that we are producing

Compensating for Moisture in Aggregates

The old fashioned way

- Water Valve (hose)
- No compensation for lost (yield) aggregate
- Inconsistent mixes (slump)
- Inconsistent strengths due to varying batch proportions and W/Cm ratio

Compensating for Moisture in Aggregates without Probes

Daily burn offs of aggregate samples

- Compensation for moisture in aggregates remains constant as long as moisture does not change between burn offs
- Can improve batch consistency (slump)
- Can improve strength consistency

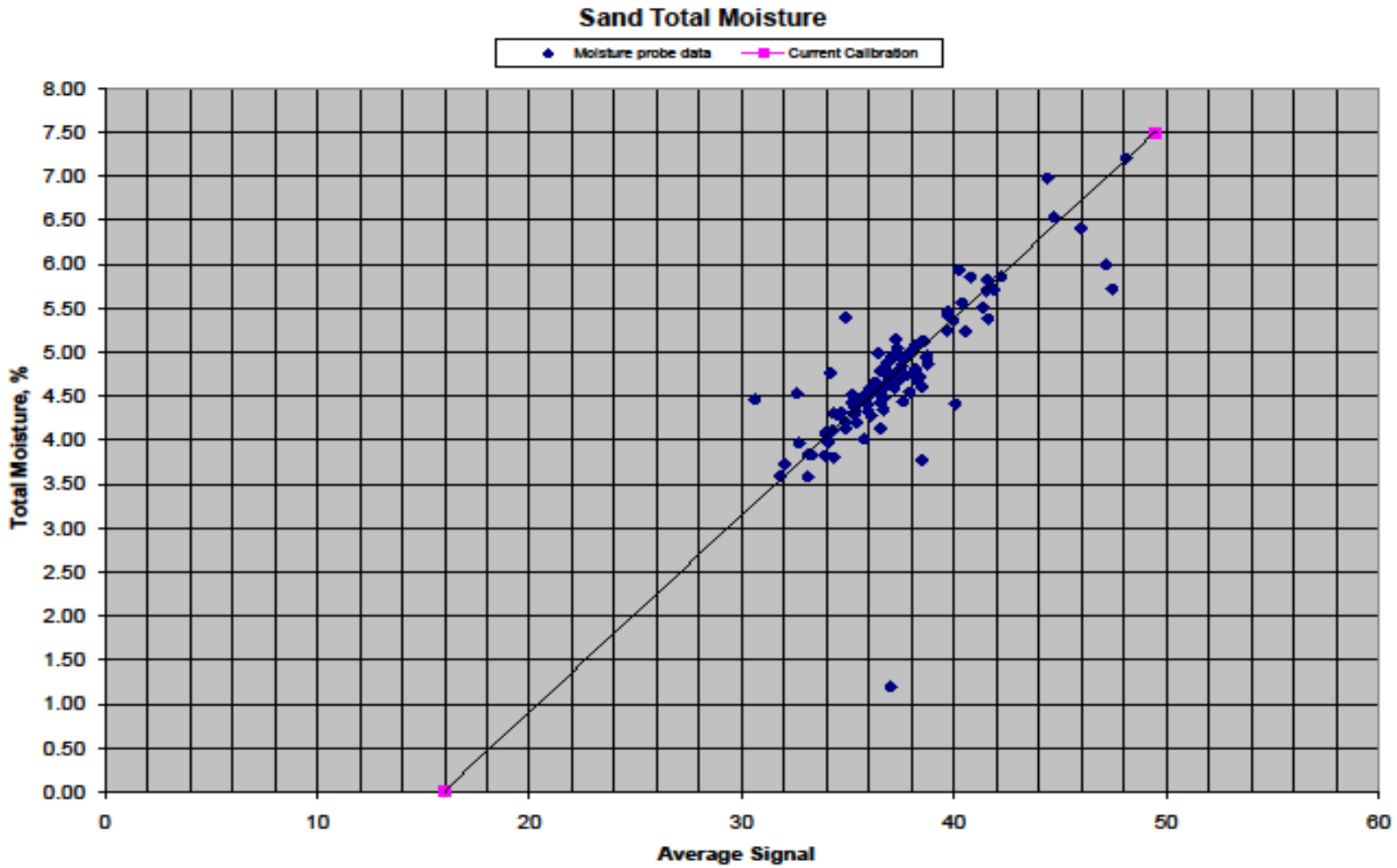
Compensating for Moisture in Aggregates

Moisture Probes

- Good batch consistency (Slump)
- Automatic compensation for Aggregates
- More consistent strengths
- Probes need to be calibrated and calibration must be checked on a routine basis based on requirements from your local agencies.

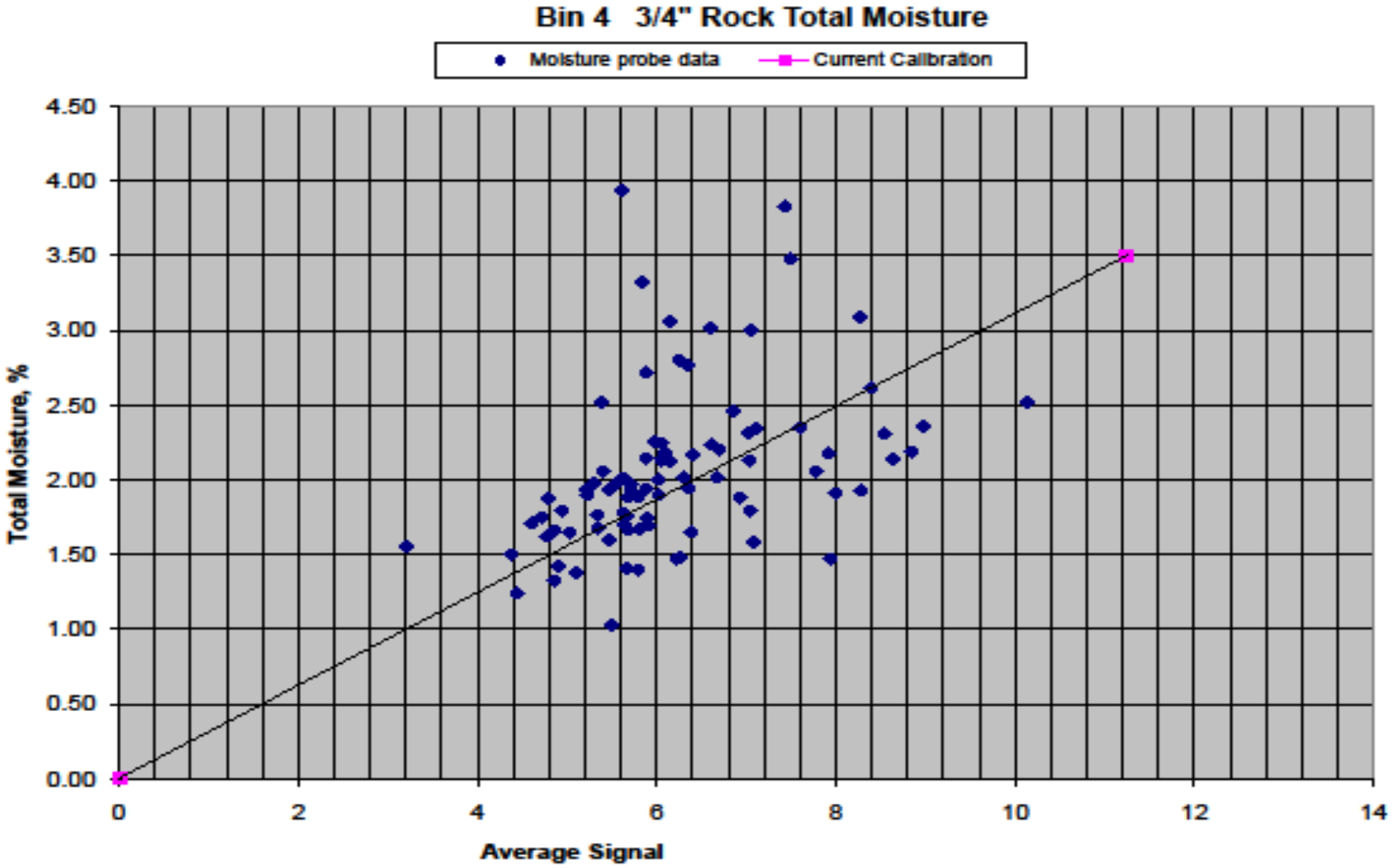
Microwave Bin Probe Calibration Plots

- Typical Sand Microwave Bin Probe Plot



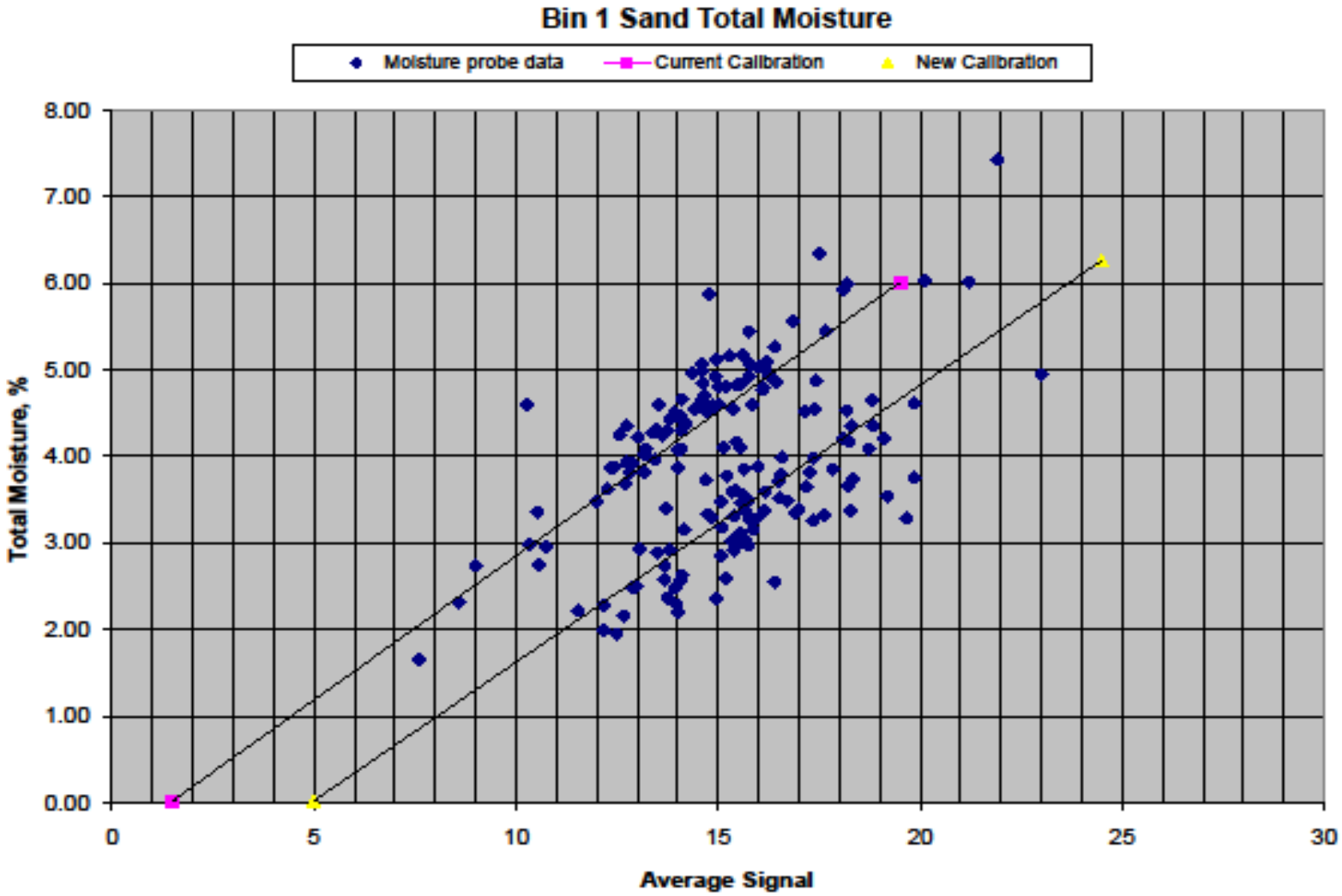
Microwave Bin Probe Calibration Plots

- Typical Rock Microwave Bin Probe Plot



Microwave Bin Probe Calibration Plots

- Shifts in Probe Calibrations



Sequencing (per manufacturer's recommendation)

- Aggregates
- Cementitious
- Water
- Admixtures (per admix manufacturer recommendation)

OR

- Aggregates
- Water
- Cementitious
- Admixtures (per admix manufacturer recommendation)

Sequencing Cement

- Depends on Mixing system
- Generally cement should be discharged when all aggregates and water are in mixer
- If cement balling occurs cement should be discharged sooner or later depending on your mixer
- Ask your mixing manufacturer for a recommended sequence and timing schedule

Why does the Sequencing of Admixtures matter?

- Mix Consistency
- Reducing the amount of additive added (cost)
- How it affects the probe readings

Air Entrainment Sequencing

- Air entraining should be added with the mix water or aggregates

- Air entraining should be mixed with aggregates for a few seconds before adding cement

Lubricant/Surfactant Sequencing (Dry Cast)

- Should be added with the aggregates and water

Water Reducer Sequencing

- Water Reducers should be added with the mix water after the air entraining is done

High Range Water Reducer (Super/Superplasticizer) Sequencing

- High Range Water Reducers should be added at the end of the batch after all ingredients are thoroughly mixed

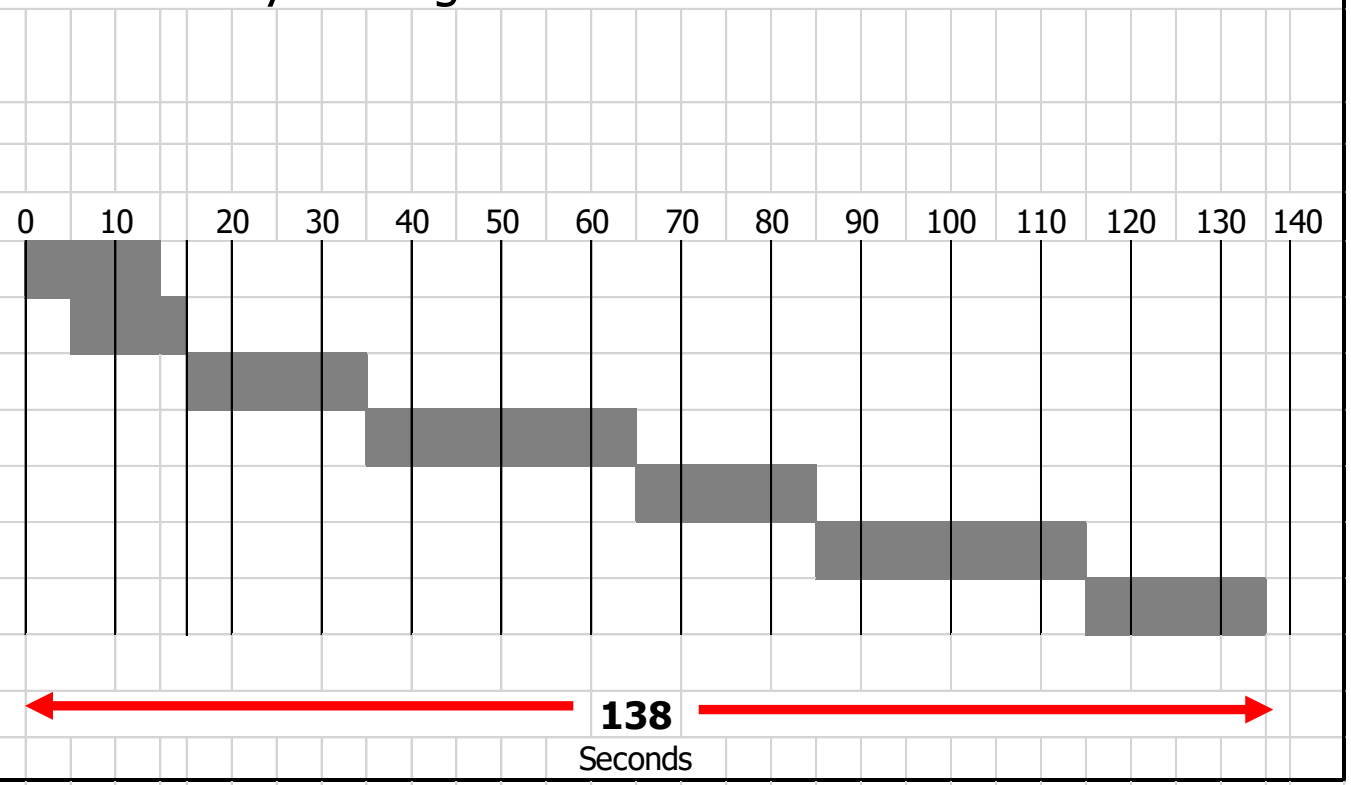
Admixture Sequencing

- Always work with your admixture supplier when you have batching sequence questions or issues

SCC Sequencing

A Typical SCC Time Cycle Diagram for 2 Yard Batch

Functions	Sequence In Seconds Time from 0	Process In Seconds Time
Charge Aggregates	0	10
Add Cement	5	8
Add Water	13	20
Mixing Time	33	30
Dose SCC Admixture	63	20
* Final Mixing Time	83	30
Discharge Mixer	113	25



* Be sure additive is thoroughly mixed in.

It is important to understand the effect of time on your concrete. The workability and quality of the concrete will deteriorate particularly in hot weather

Mixers

Mixer Output

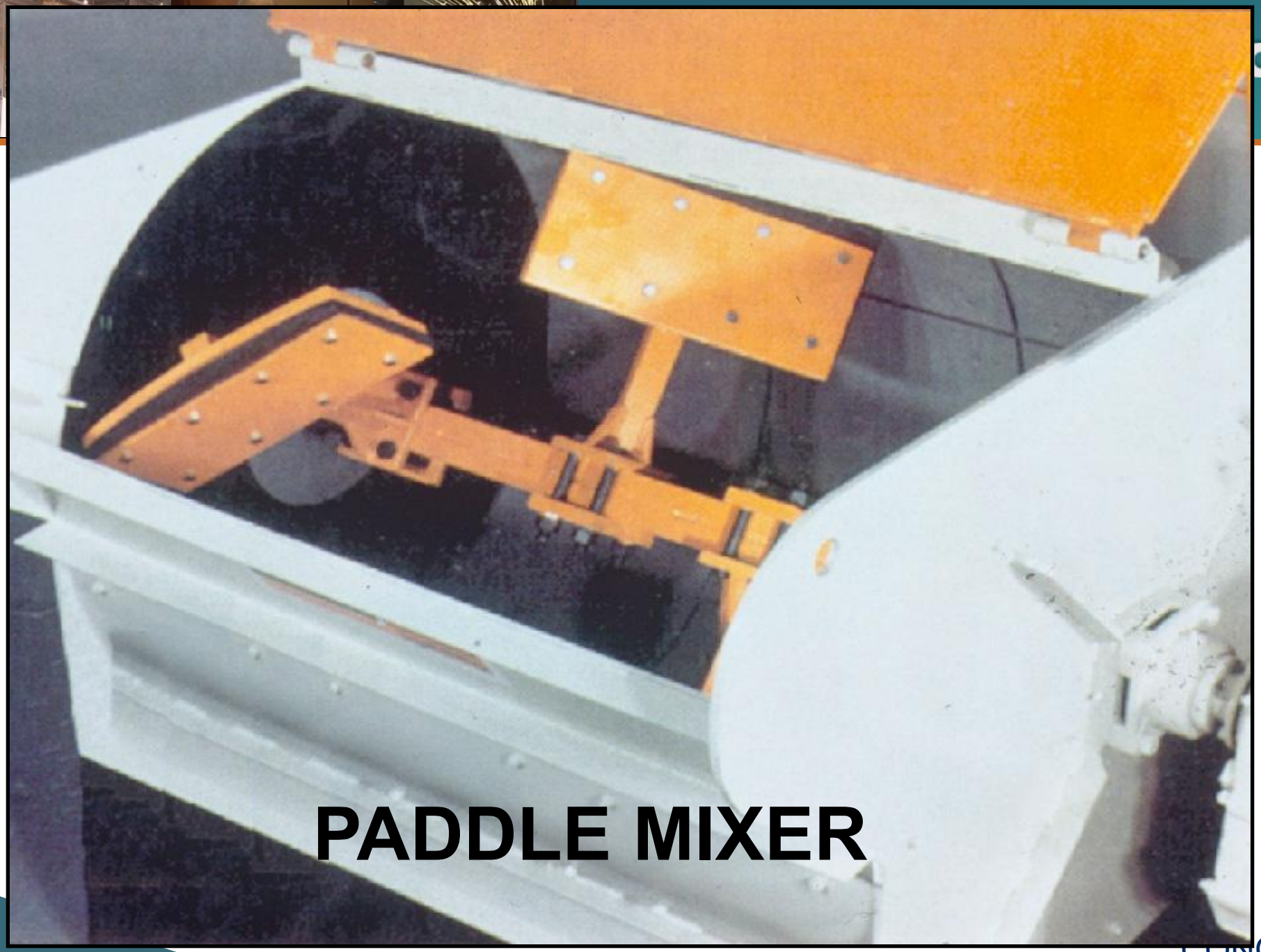
- Quantity of concrete needed per day
- Quantity of concrete needed per hour

Mixer Output

- Output is measured in:
  - ft^3
  - yd^3
  - m^3
- **Typically 2/3 of rated capacity!!!**

Common Types of Mixers

- Paddle Mixers
- Ribbon/Spiral Blade Mixers
- Pan Mixers
  - Counter-Current
    - Rotating Pan
    - Stationary Pan
- Twin-Shaft Mixers



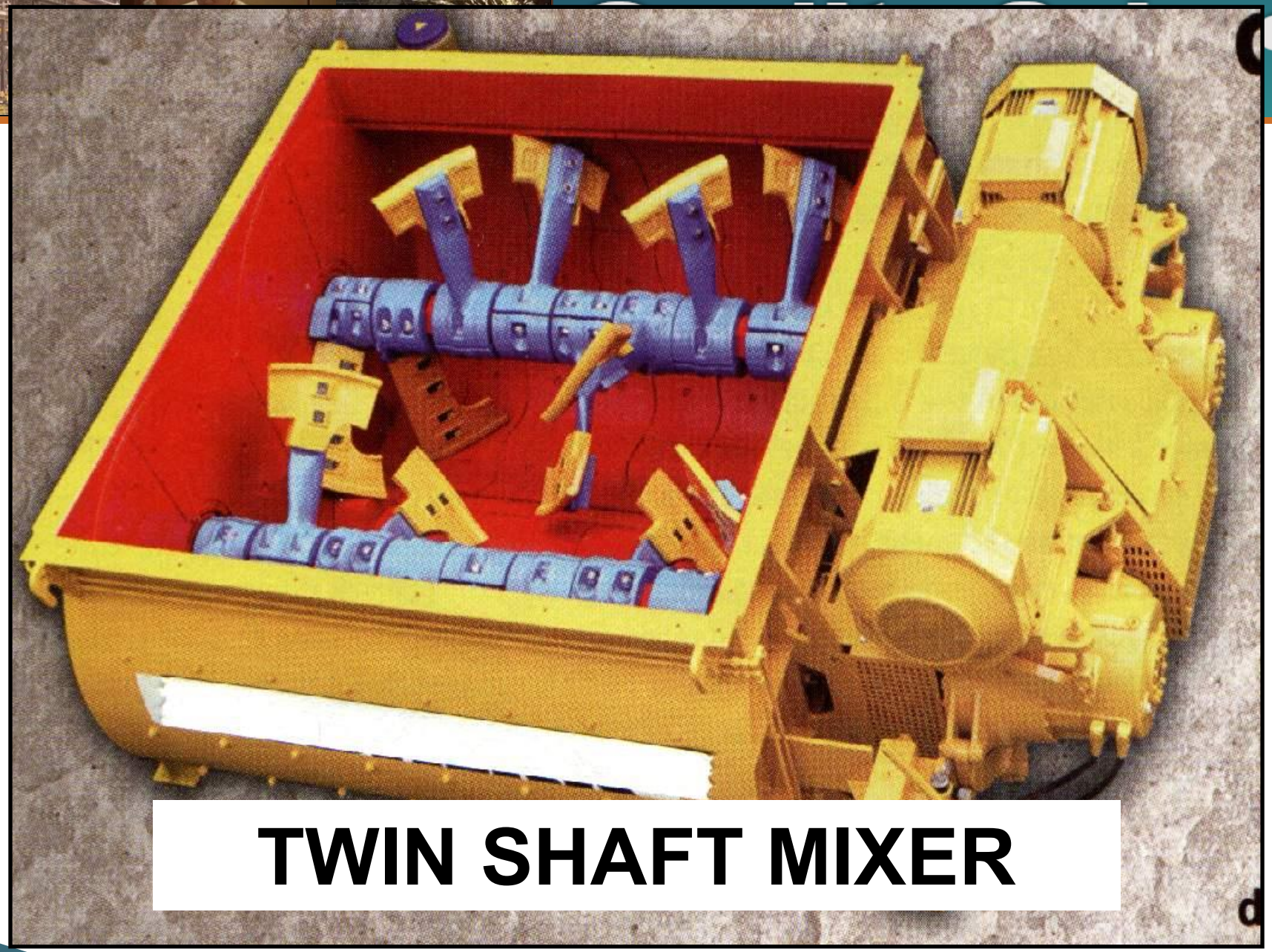
PADDLE MIXER

RIBBON MIXER

TURBINE MIXER

COUNTER CURRENT MIXER


PAN MIXER

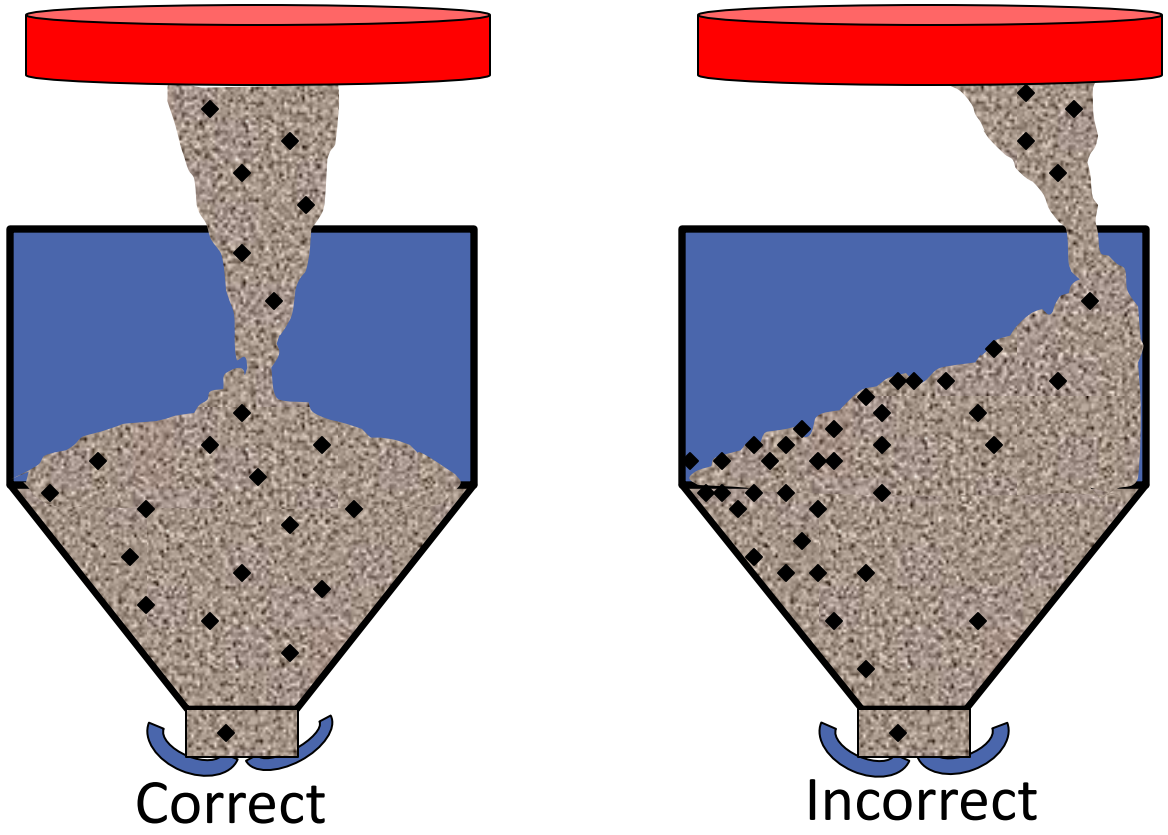


TWIN SHAFT MIXER

Concrete Transport

Concrete Discharge from Mixer

Discharge into center of bucket or hopper



Handling Concrete

- Avoid
  - Segregation
  - Loss Of Mortar
  - Loss of Slump

Segregation

- Most common cause of damage occurs:
  - if concrete is not discharged vertically
  - at free-fall distances more than 6 feet
  - when jarring or shaking during transportation

- Open chutes
  - more than 20’ Long
  - chutes that are too steep (slide not tumble)

Pouring Concrete

- Place concrete in the form near its final location
- Keep free-fall to a minimum
- Use flat forms
  - Begin pour at corner or edge
  - Pour in equal lifts
- Vertical Forms
  - Pour in horizontal layers
  - For large blockouts, pour on one side - allow concrete to flow underneath


Questions?
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