



Concrete Batching Operations

A photograph of a concrete batching plant. The scene features several large, cylindrical silos and a complex network of metal structures, including ladders, walkways, and conveyor belts. A large, funnel-shaped hopper is visible on the right side. In the foreground, there are utility boxes and a fence. The background shows a clear blue sky and distant mountains. The text "Concrete Batching Operations" is overlaid on the bottom right of the image.

Concrete Batching Operations

Concrete Batching Operations



Wet Mix Batching Operation



Dry Mix Batching Operations



Dry Mix Batching Operation



Wet Mix Batching Operation



Wet Mix Batching Operation



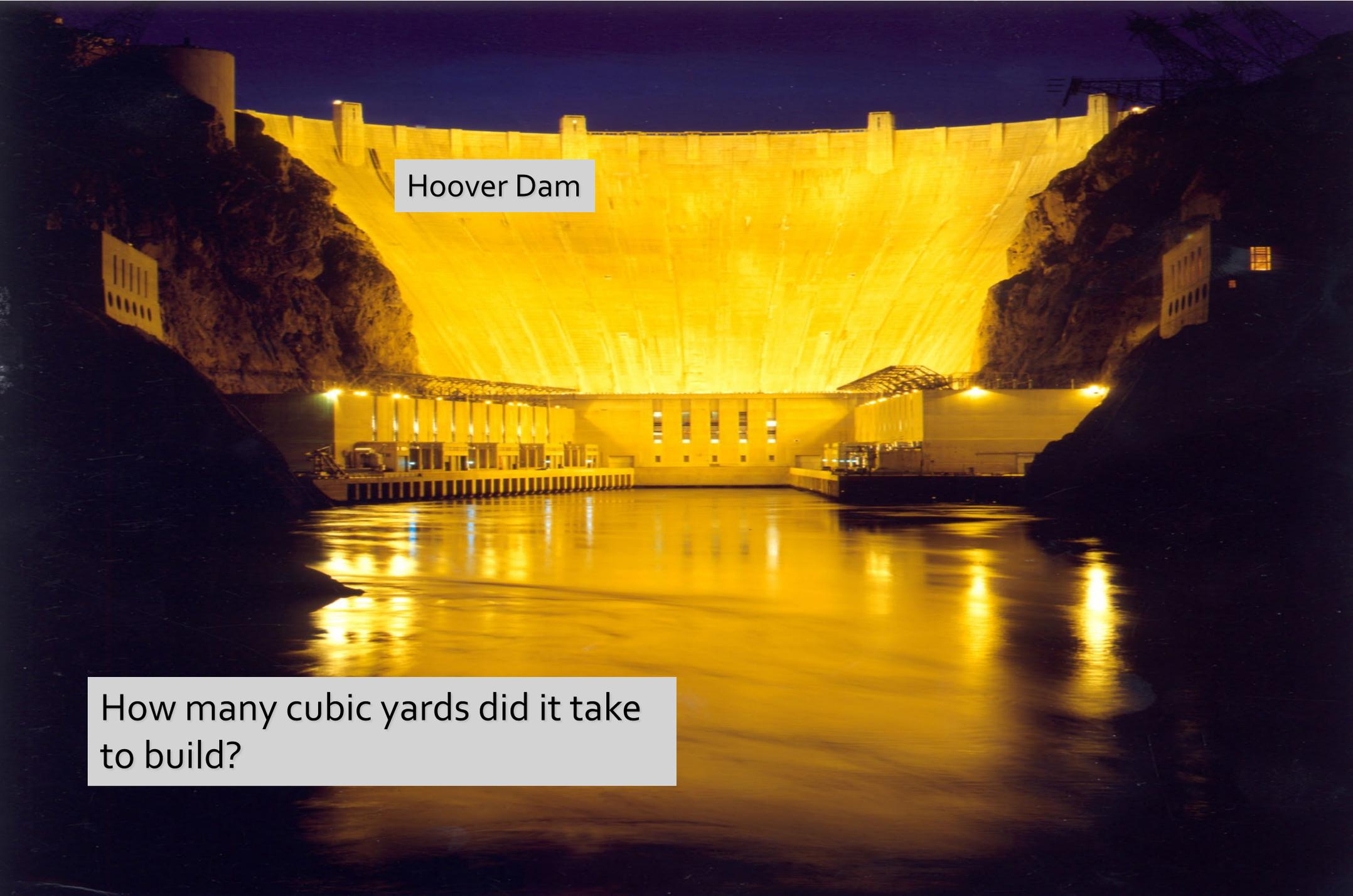


Violations?



Overview

- Introduction
- Industry History
- Emissions and Health Impacts
- Concrete Industry Description
- Inspection Procedures
- Engineering Evaluation/Permit Process

A photograph of the Hoover Dam at night, illuminated with warm yellow lights. The dam's massive concrete structure is the central focus, with its spillways and intake towers visible. The water in the foreground is dark, reflecting the lights from the dam. The surrounding cliffs are dark, with some small lights visible on the right side. The overall scene is dramatic and highlights the scale of the engineering project.

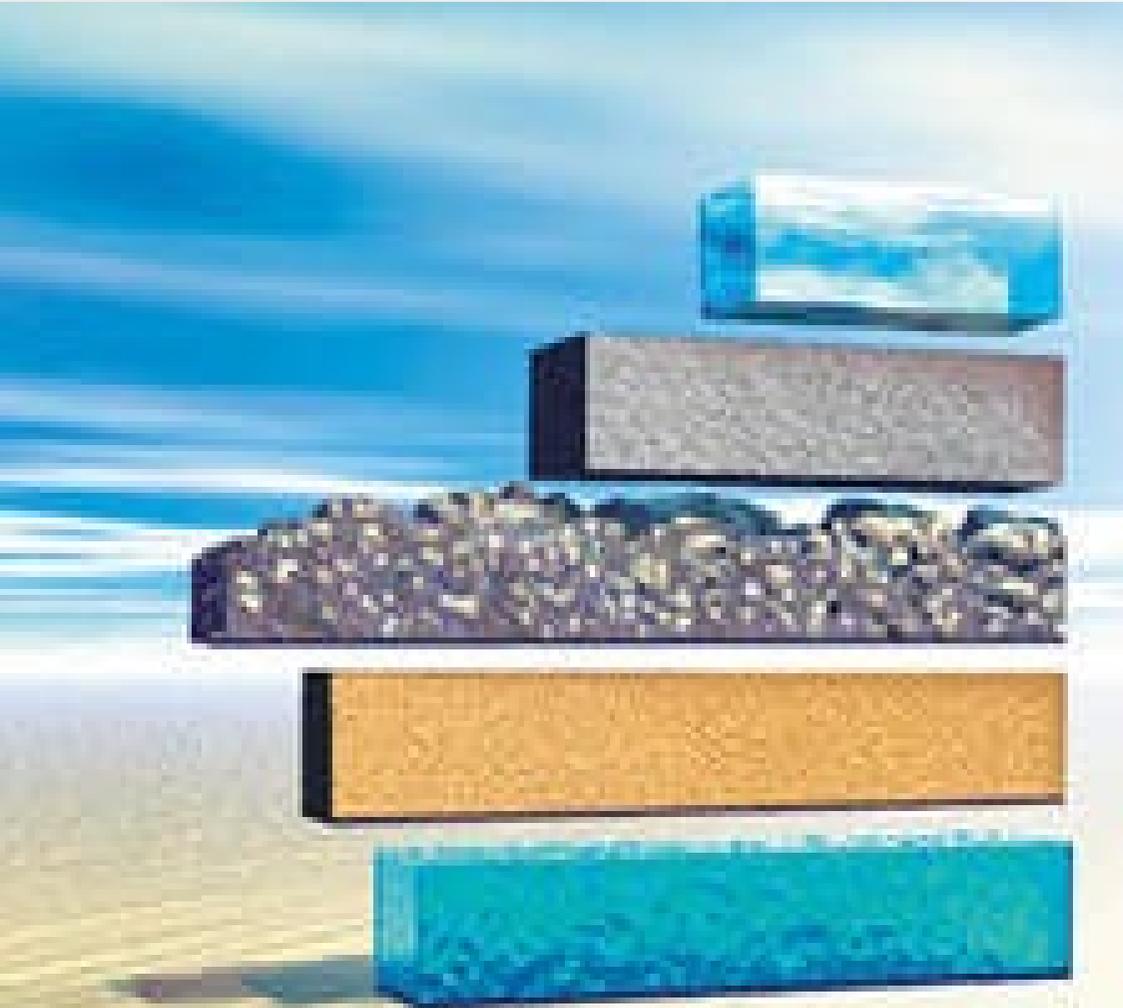
Hoover Dam

How many cubic yards did it take to build?

Concrete Batching Operations



Constituents



Basic Ingredients

11% Portland Cement

41% Aggregate or Course Stone

26% Sand

16% Water

Balance: Inert Material

What is Concrete?

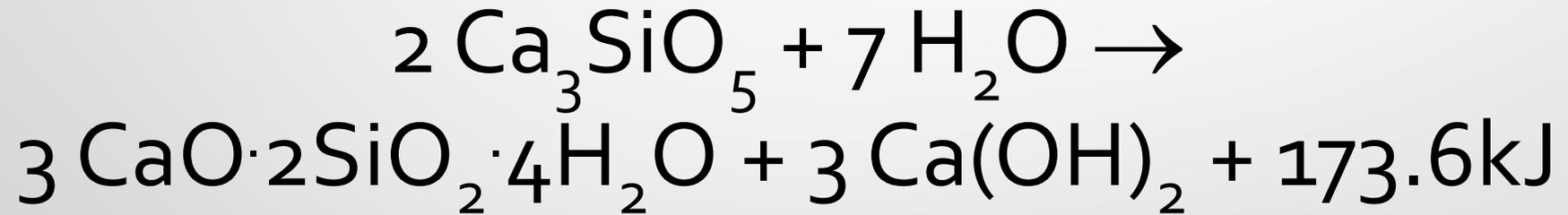


A combination of water, sand, rock, and portland cement mixed together to harden.

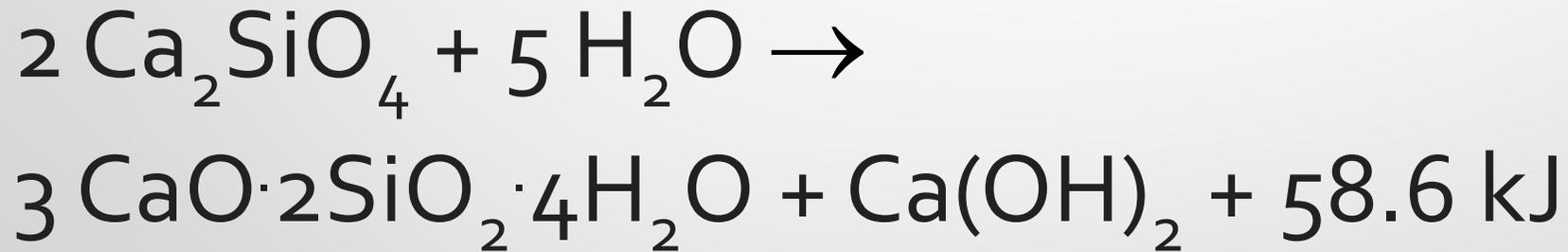
Composition of Portland cement with chemical composition and weight percent.

Cement Compound	Weight Percentage	Chemical Formula
Tricalcium silicate	50 %	Ca_3SiO_5 or $3\text{CaO}\cdot\text{SiO}_2$
Dicalcium silicate	25 %	Ca_2SiO_4 or $2\text{CaO}\cdot\text{SiO}_2$
Tricalcium aluminate	10 %	$\text{Ca}_3\text{Al}_2\text{O}_6$ or $3\text{CaO}\cdot\text{Al}_2\text{O}_3$
Tetracalcium aluminoferrite	10 %	$\text{Ca}_4\text{Al}_2\text{Fe}_2$ or $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$
Gypsum	5 %	$\text{CaSO}_4\cdot 2\text{H}_2\text{O}$

Tricalcium silicate + Water →
Calcium silicate hydrate +
Calcium hydroxide + heat



Dicalcium silicate + Water →
Calcium silicate hydrate +
Calcium hydroxide + heat

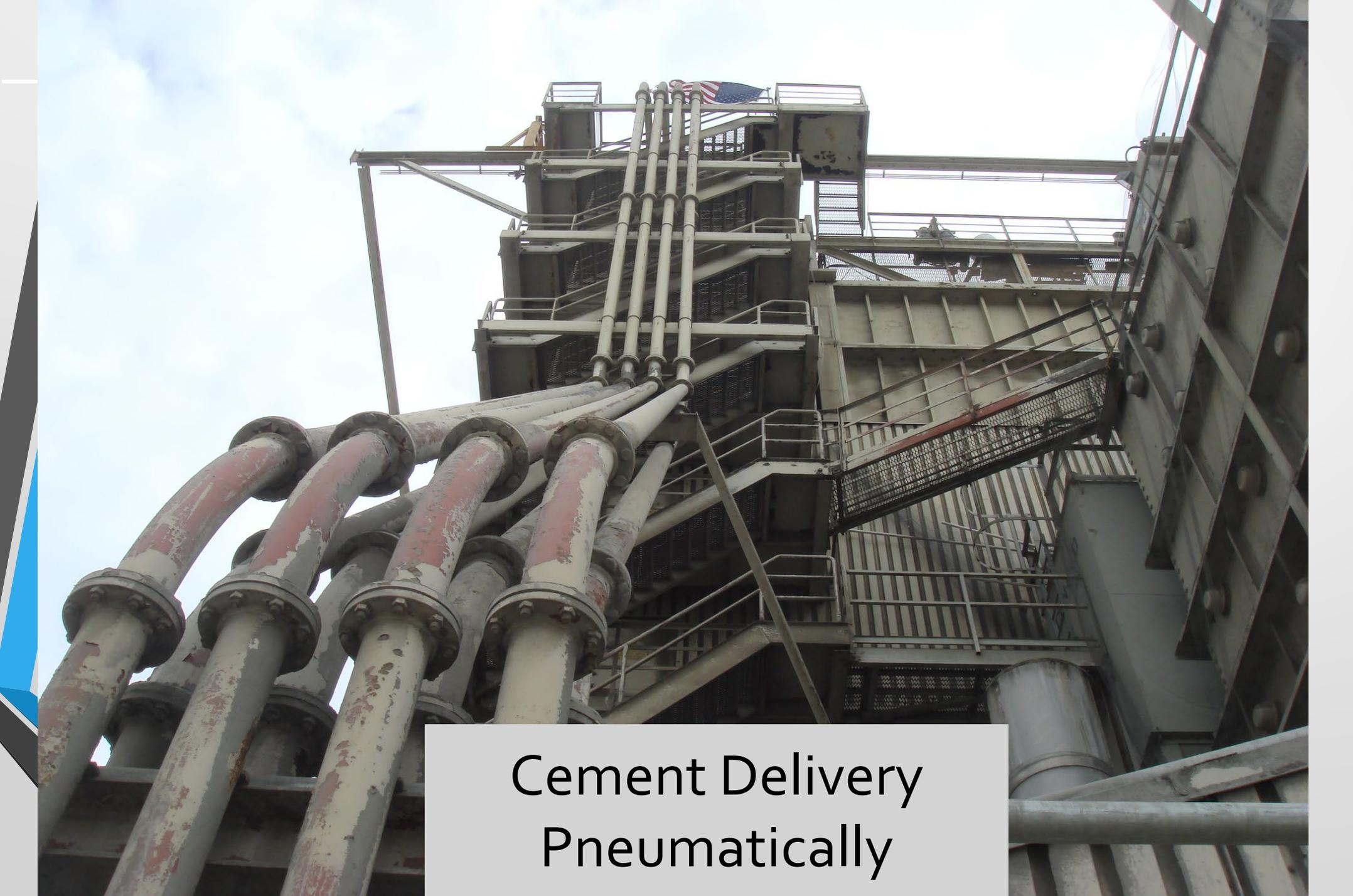


Concrete Batching Operations





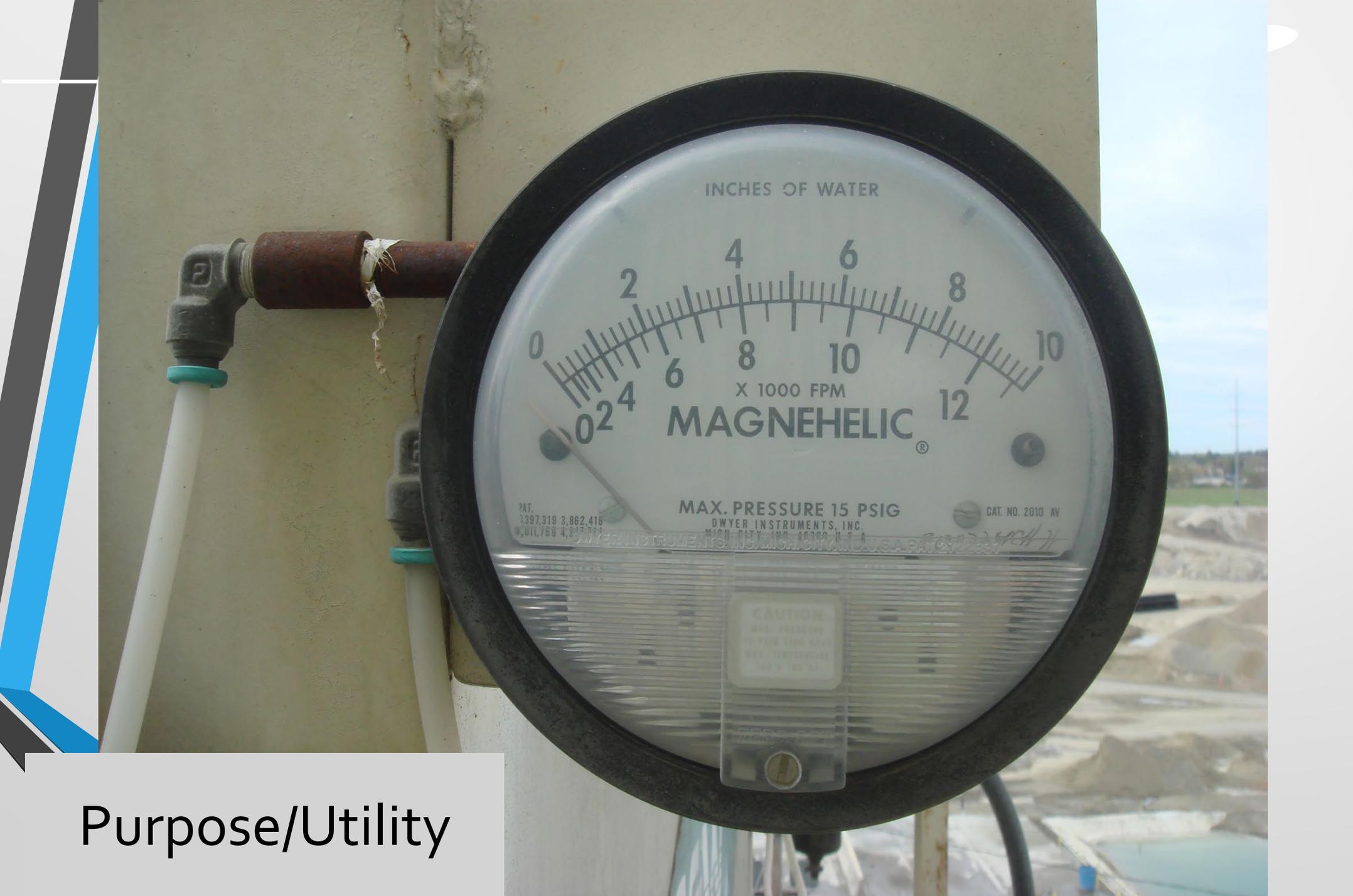
Cement Delivery
Pneumatically



Cement Delivery Pneumatically



Dust Collectors Serving
Cement/Fly Ash/Slag Silos



Purpose/Utility

Stacking Conveyors



Aggregate from a Crushing Plant



Concrete Sand From a Wash Plant



Aggregate Delivery via Conveyors



Aggregate Delivery via Conveyors: Safety

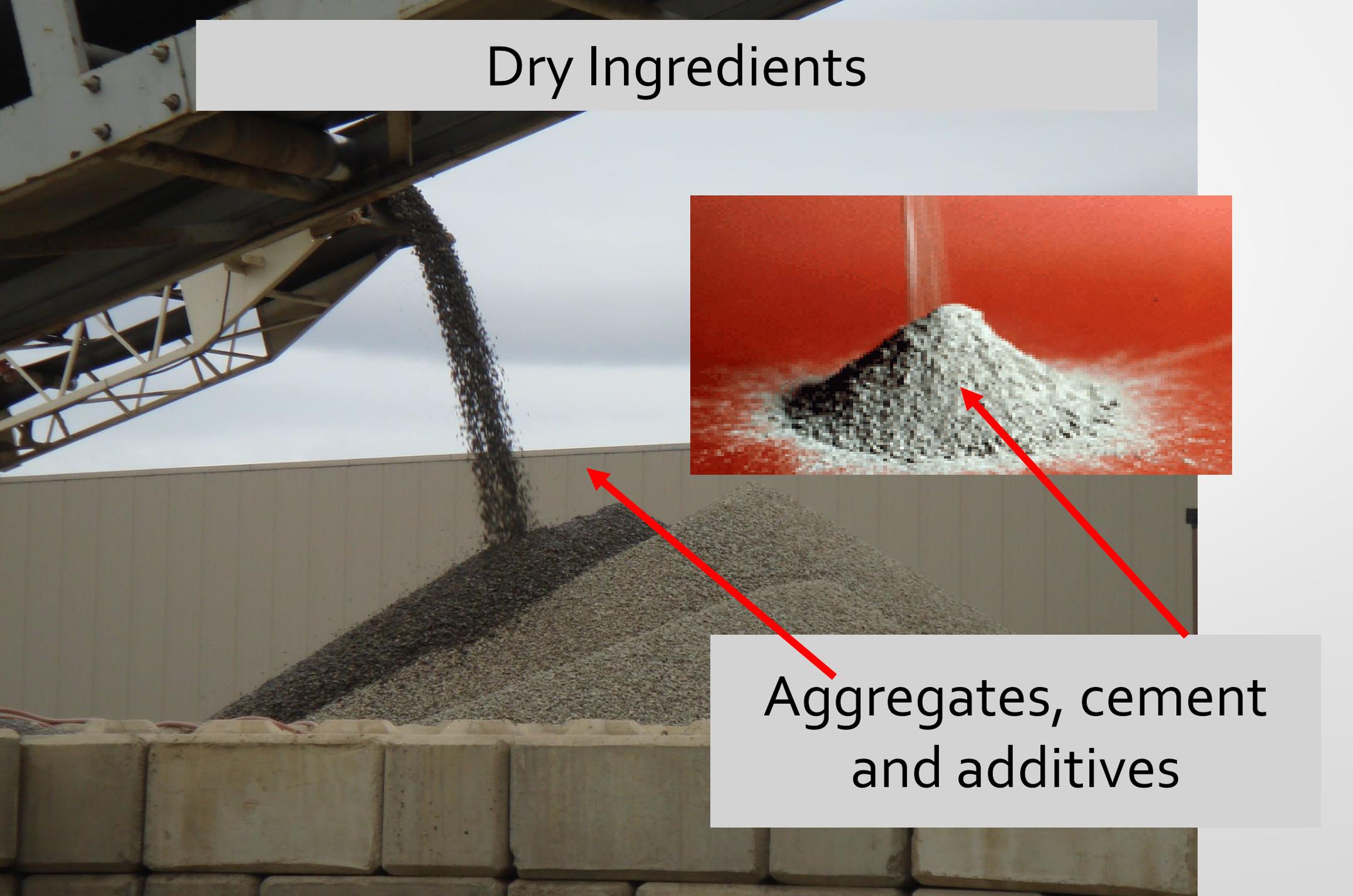




Concrete Batching Process

- Store, convey, measure, and then discharge the ingredients to make concrete into equipment that mixes, packages, or transports the mixture for use

Dry Ingredients



Aggregates, cement
and additives

Additive Ingredients





Ingredients

- Air retaining Agents - Provides resistance
- Water Reducing - Reduces the amount of water needed
- Accelerating Agents - Shortens setting or cure time
- Retarding Agents - Slows the setting/cure time
- Fungicides - Prevents fungus or bacterial growth

Concrete Batching Process



75% of U.S. concrete is produced at plants that

1. Store
2. Convey
3. Measure
4. Mix
5. Discharge into trucks

Types of Concrete Batching Process

Transit Mix



Central Mix



Ready Mix



Concrete Batching Process

Moisture Sensors

Scales,
load cells

Silo Weighing
and Inventory

Mixer

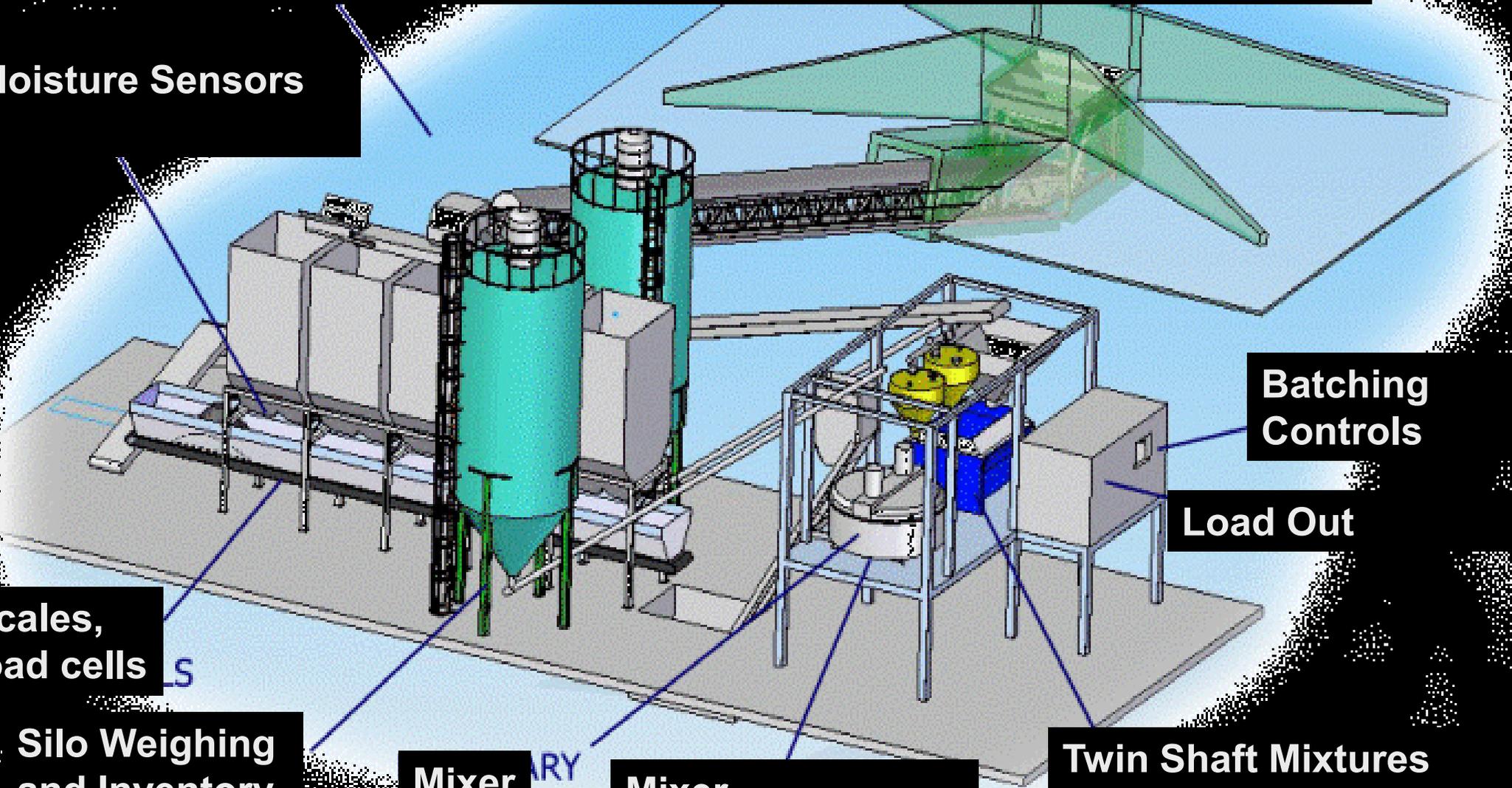
Mixer
Moisture Controls

Batching
Controls

Load Out

Twin Shaft Mixtures

MIXERS



Concrete Batching Process: Types of Emissions

- Particulate Matter
- Combustion Emissions

Concrete Batching Process



Sprinkler and

Load Out Grizzly

Concrete Batching: Stockpiles





Concrete Batching: Aggregate Conveyors

Concrete Batching: Storage of Dry Ingredients



Concrete Batching: Raw Material Receiving & Storage



Concrete Batching: Raw Material Receiving & Storage



Aggregate Screen & Surge Bin

Concrete Batching: Moisture Sensor



Concrete Batching: Cement Receiving & Storage



Concrete Batching: Cement Receiving & Storage



Concrete Batching: Cement Receiving Pneumatic Pumps



Concrete Batching: Cement Receiving Pneumatic Pumps

- Dense-phase Pneumatic Conveying
 - Moves material at low velocity to prevent material degradation and equipment wear
 - Reduces segregation and promotes flow
 - Dry bulk material is typically loaded into a vessel called a *transporter*
 - Pressurized from 15 to 60 psi



**Concrete Batching: Cement
Receiving Pneumatic Pump**

Concrete Batching: Cement Receiving Silo

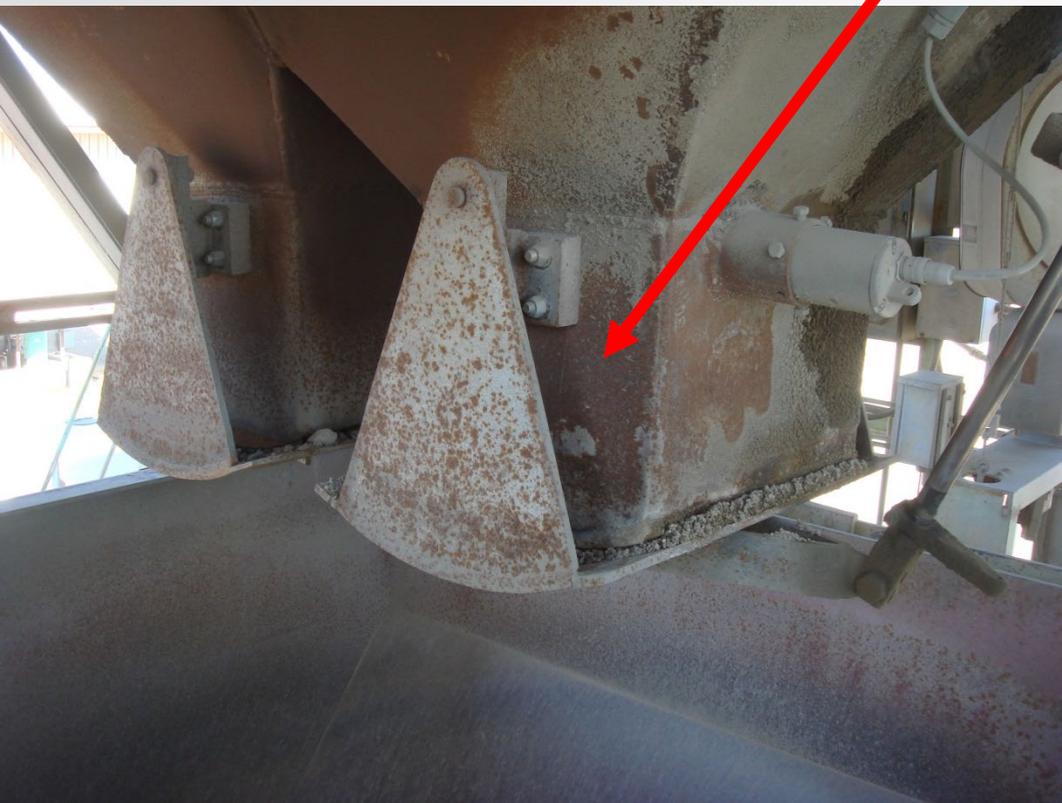


Concrete Batching: Cement Loadout

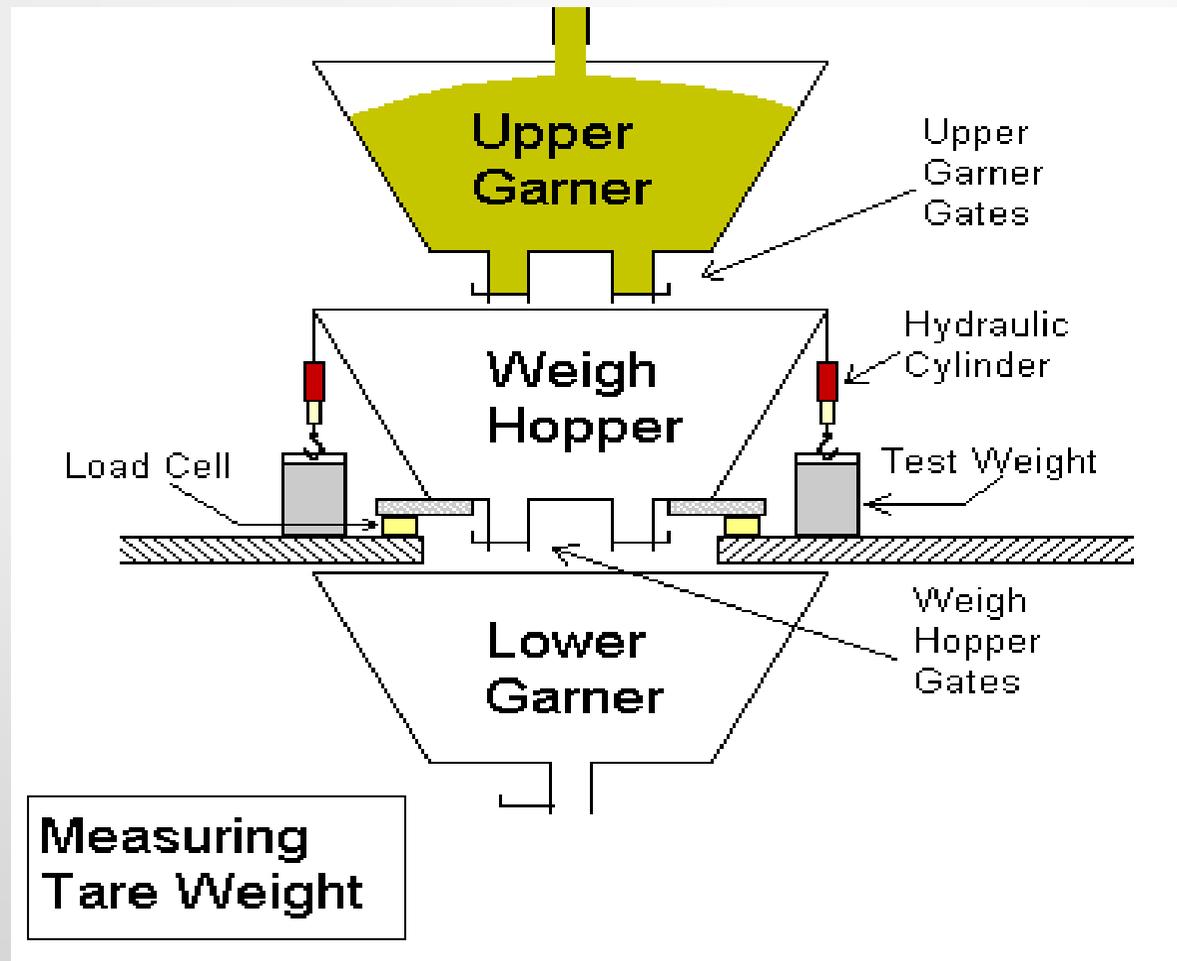


Concrete Batching: Weigh Hopper

Weigh Hopper



Bulk-Weighing Scale



Load Out Area



3/1/2022

Bin Vent Filter Serving Loadout



Bin Vent Filter Serving Silos



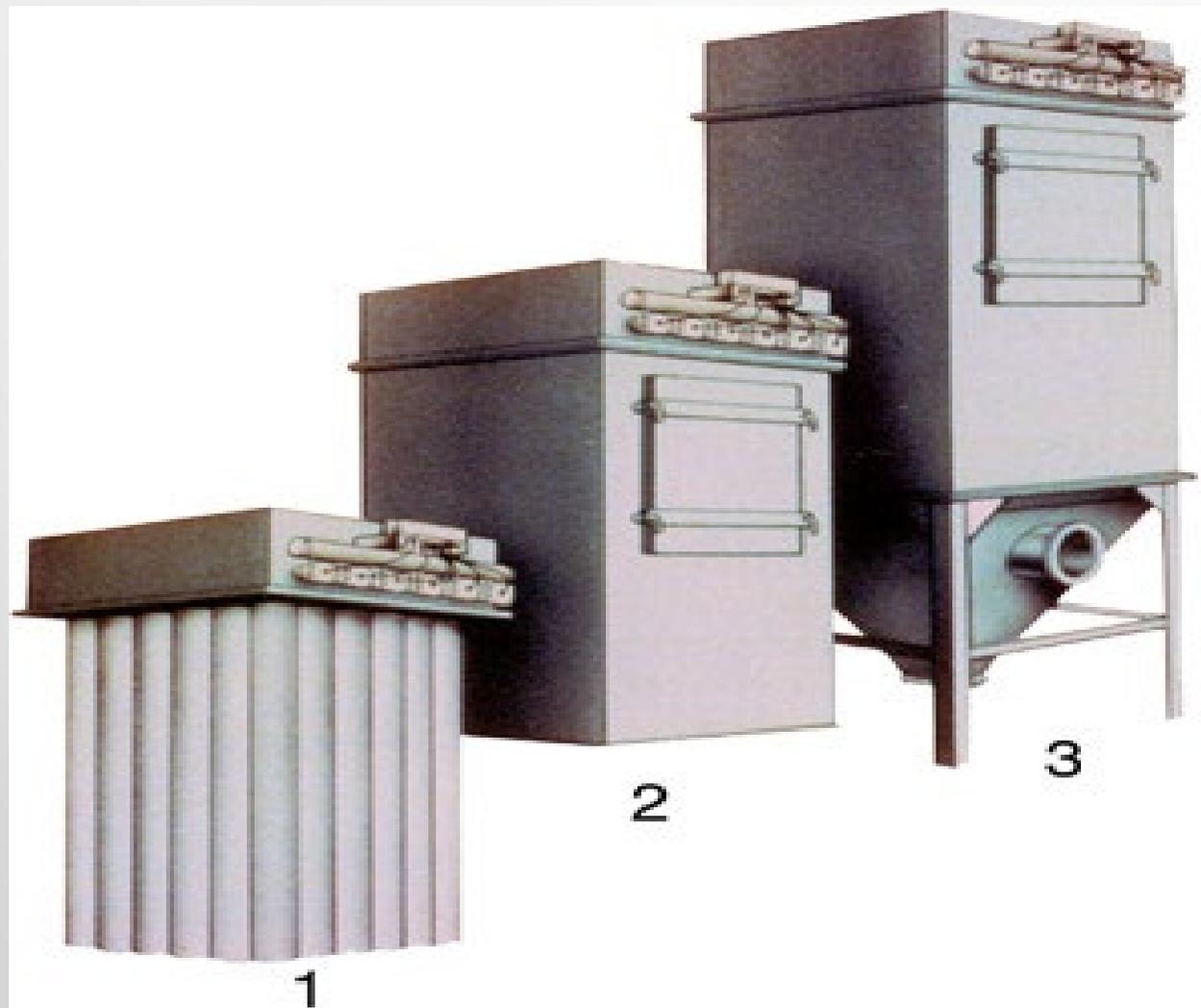
Bin Vent Filter Serving Loadout





Bin Vent Filters

Bin Vent Filters



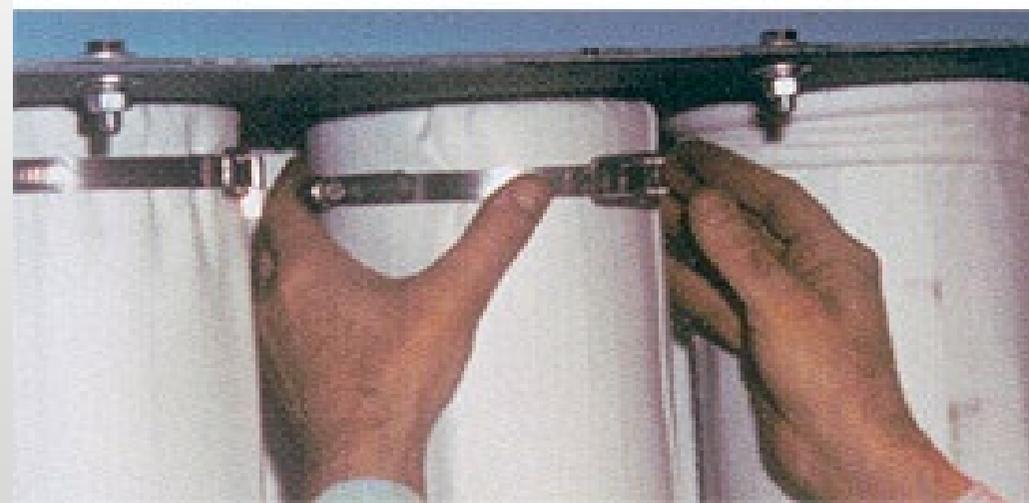
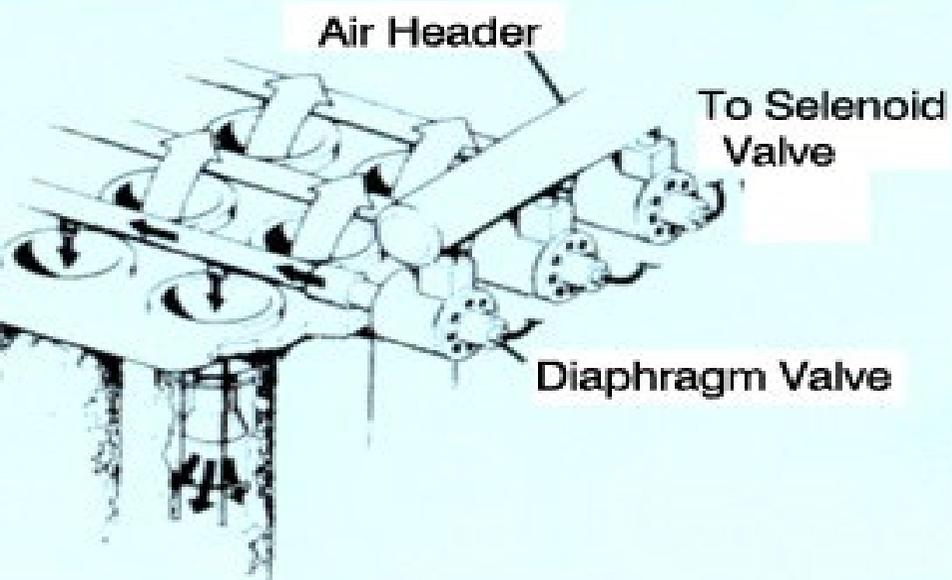
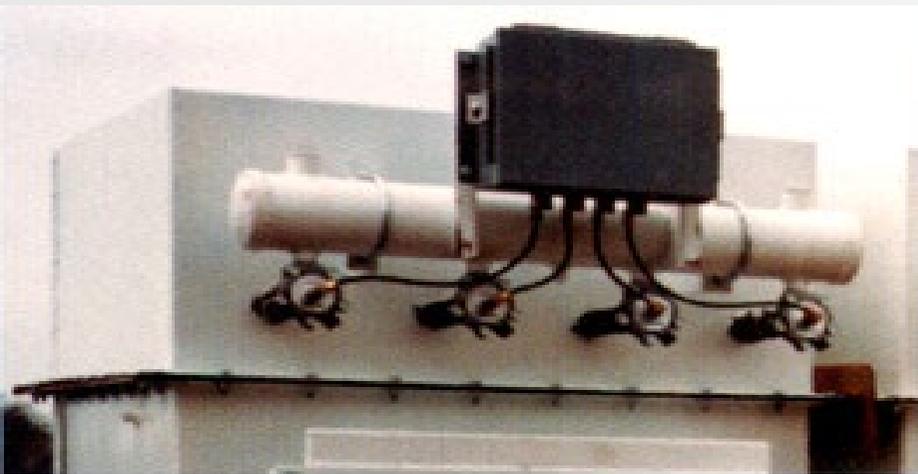
Bin Vent Filters





Bin Vent Filters

Bin Vent Filters





Concrete Batching Process: Central Mix



Concrete Batching Process: Ready Mix



Concrete Batching Process: Ready Mix

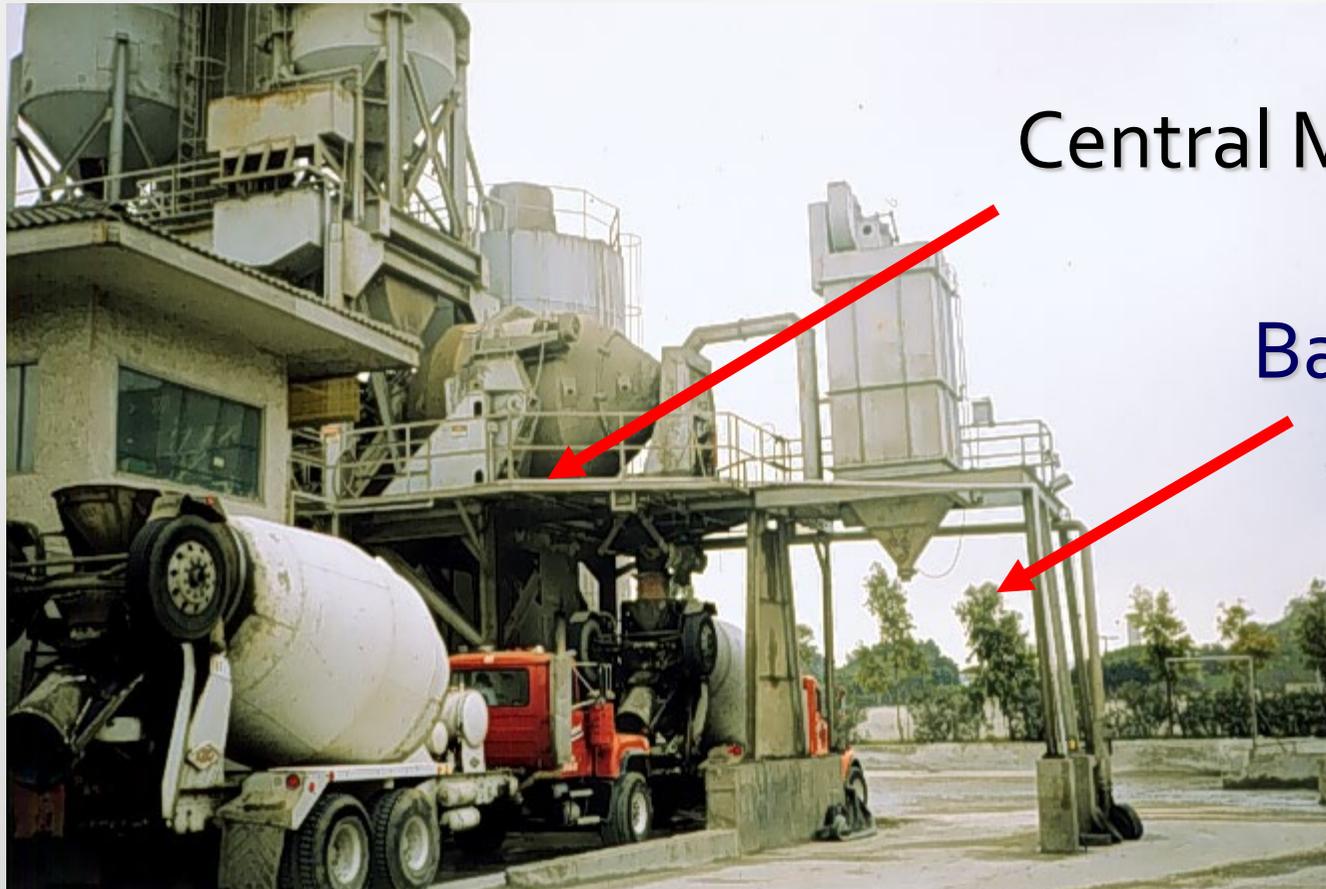
A photograph of a large industrial machine, possibly a conveyor system or a large-scale material processing unit. The machine is primarily grey and green. A prominent feature is a large, corrugated metal duct that curves from the right side towards the center. To the left, there is a large yellow cylindrical tank. The machine is supported by a complex network of green metal beams and pipes. The scene is brightly lit, suggesting an outdoor industrial setting.

**Wait a minute before
you loadout!**



Not acceptable!!

Concrete Batching Process



Central Mix

Batch Mix

Concrete Batching Process: Batch Mix



Concrete Batching Process: Central Mix



Central Mix

water





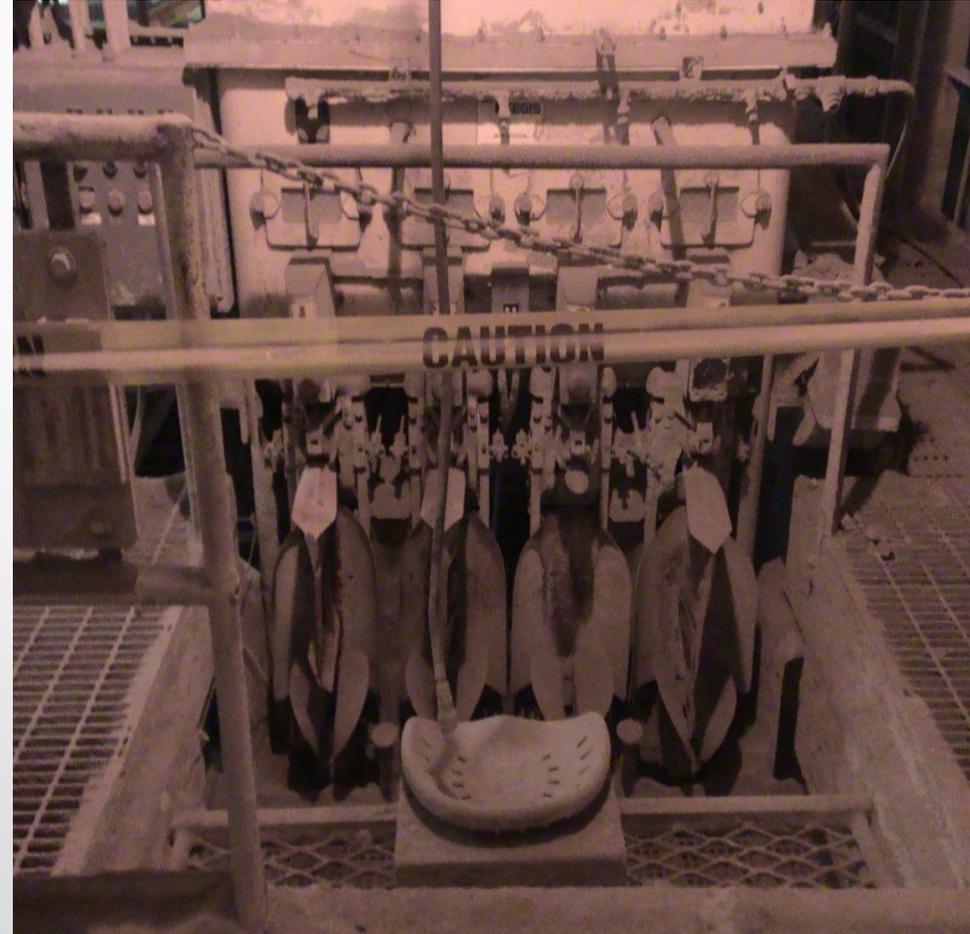
Concrete Batching Process: Rinsing

3/17/2022

Concrete Ready Mix: Bagging Operation



Concrete Ready Mix: Bagging Operation



Concrete Batching Operation



Portable Plant

PERP vs Non-PERP

Not Portable Equipment

- Remains in same location more than 12 consecutive month
- Remains in same location less than 12 consecutive months, but production is equal to annual source operations (seasonal sources)
- Unit is moved and returned to the same location

Industry Description

Concrete Recycling





Concrete Recycling



**Crusher separates
metal from
Concrete**

Concrete Recycling





Water Spray



Magnet Used
to remove
material

Screens

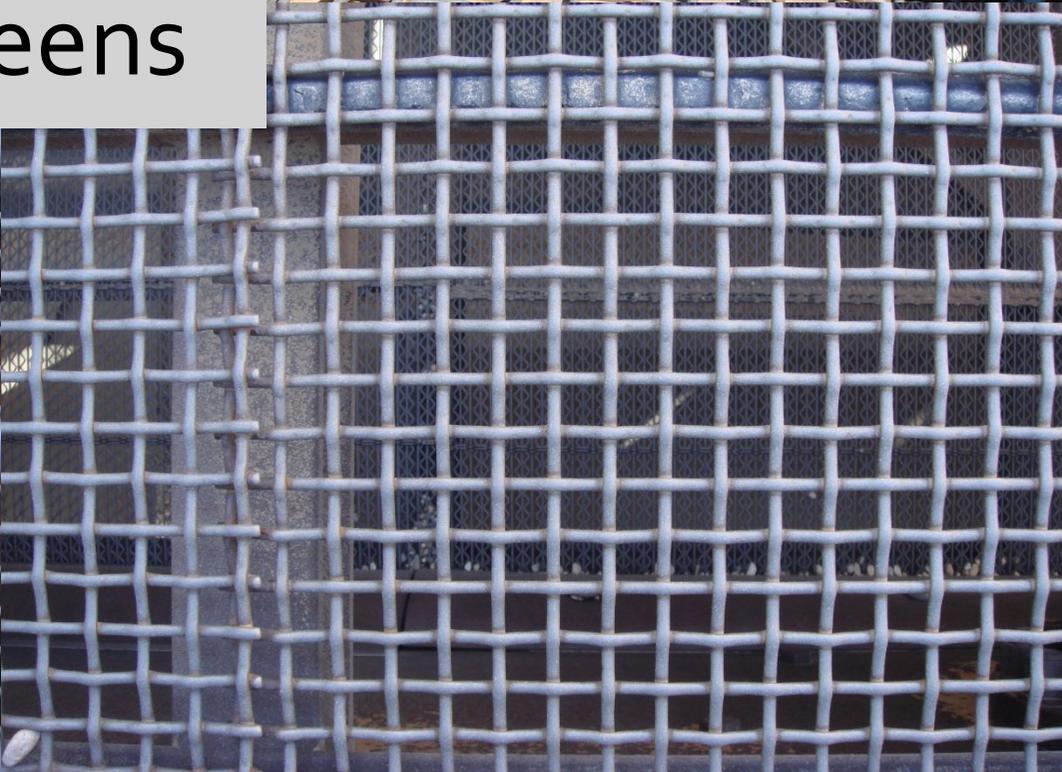




Screening Operations



Screens



Aggregate Storage Piles





Aggregate Storage Piles



Air Quality Concerns

- PM from cement dust & concrete batching process
- 10% to 20% are smaller than 5 microns in diameter
- PM₁₀ & PM_{2.5} have health impacts



Inspection Procedures: Bags



Inspection Procedures: Puffing Due to Improper Maintenance



Inspection Procedures: Clogged Bags



Inspection Procedures: Storage Hoppers





Inspection Procedures: Fugitive Dust

Inspection Procedures: Preventative Measures

- Passive enclosures
- Wet suppression & baghouse maintenance
- Paved surfaces Work practices
- Housekeeping



Inspection Procedures: Preventative Measures

- Water sprays
- Enclosures or hooding transfer points and screening operations
- Maintaining good housekeeping
- Air pollution control systems in order
- Covers & wind barriers

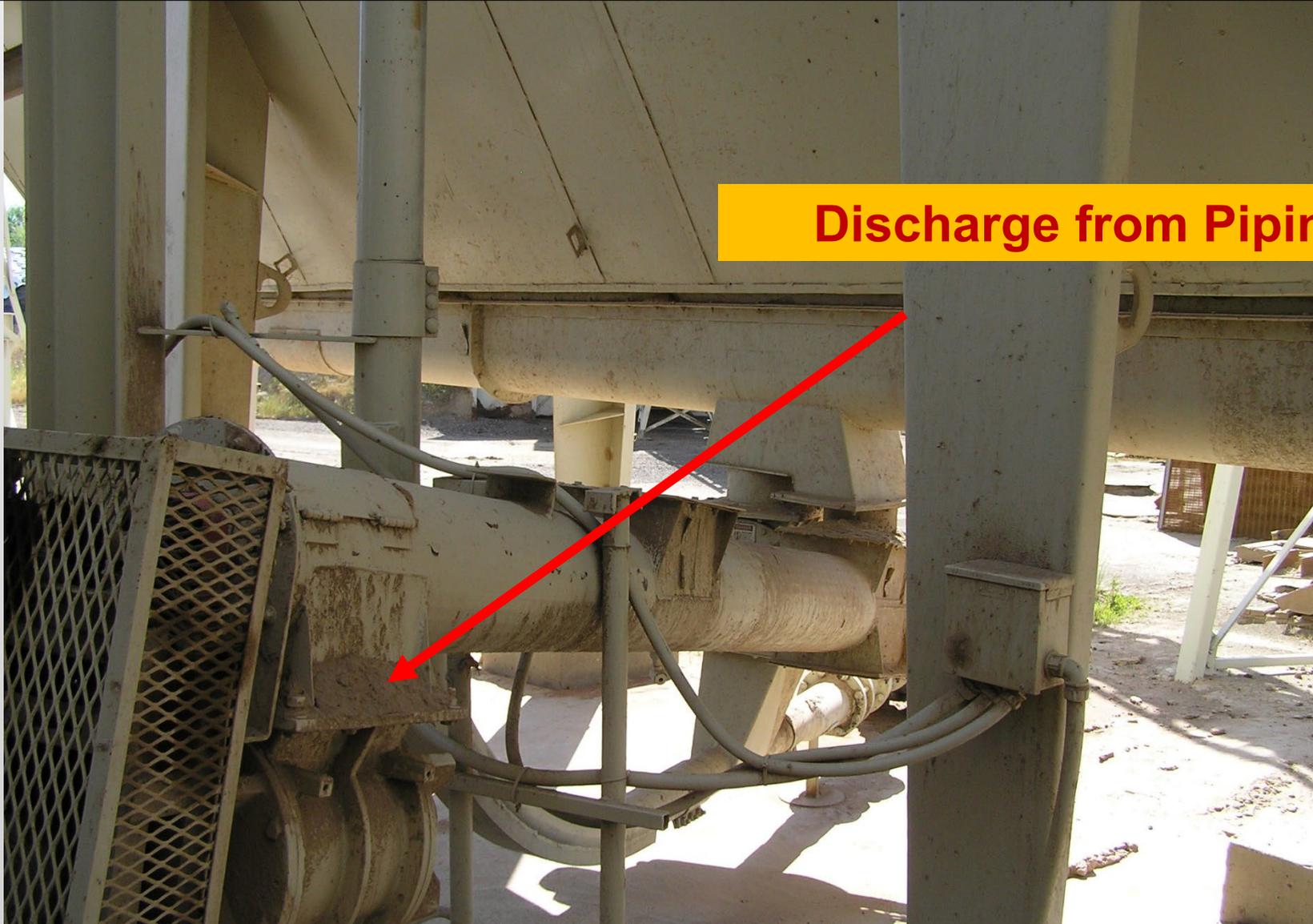
Inspection Procedures: Preventative Measures

Discharge from Conveyor



Inspection Procedures: Preventative Measures

Discharge from Piping



Inspection Procedures: Preventative Measures



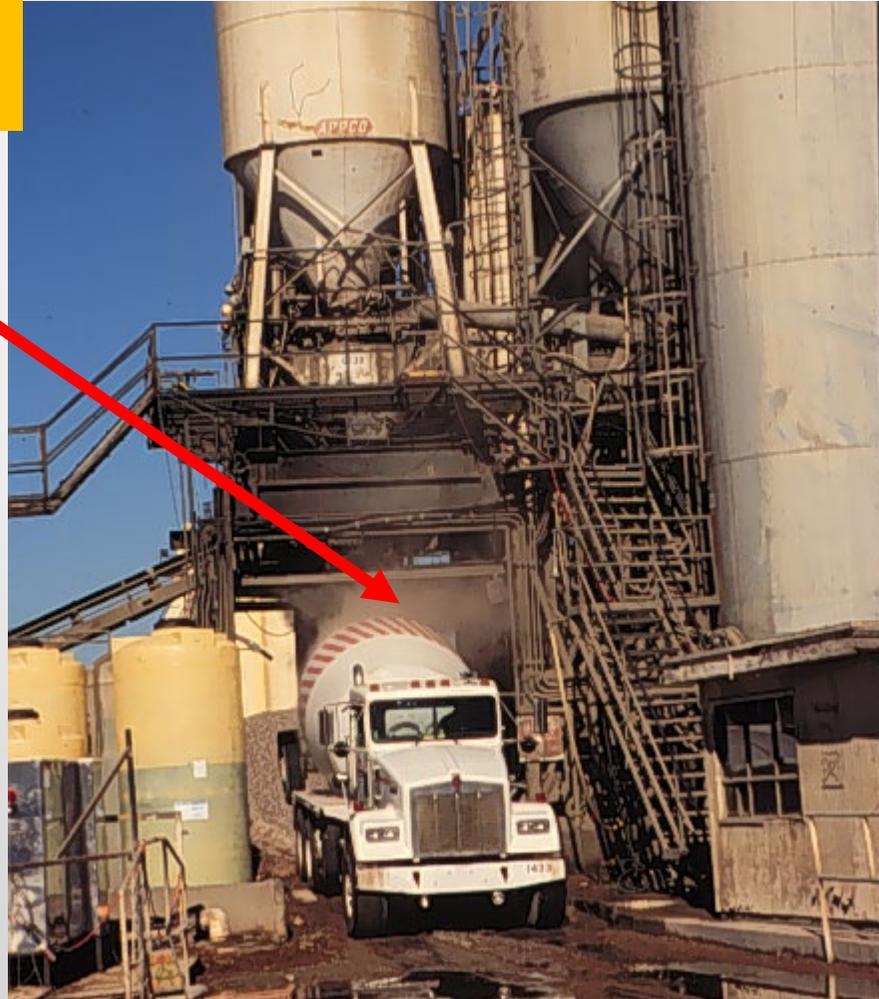
Packaging

3/1/2022

95

Inspection Procedures: Preventative Measures

Lack of Dust
Control



Lack of Dust Control



**Inspection Procedures:
Preventative Measures**

Dust Control



**Inspection Procedures:
Preventative Measures**



**Inspection Procedures:
Water Spray System**

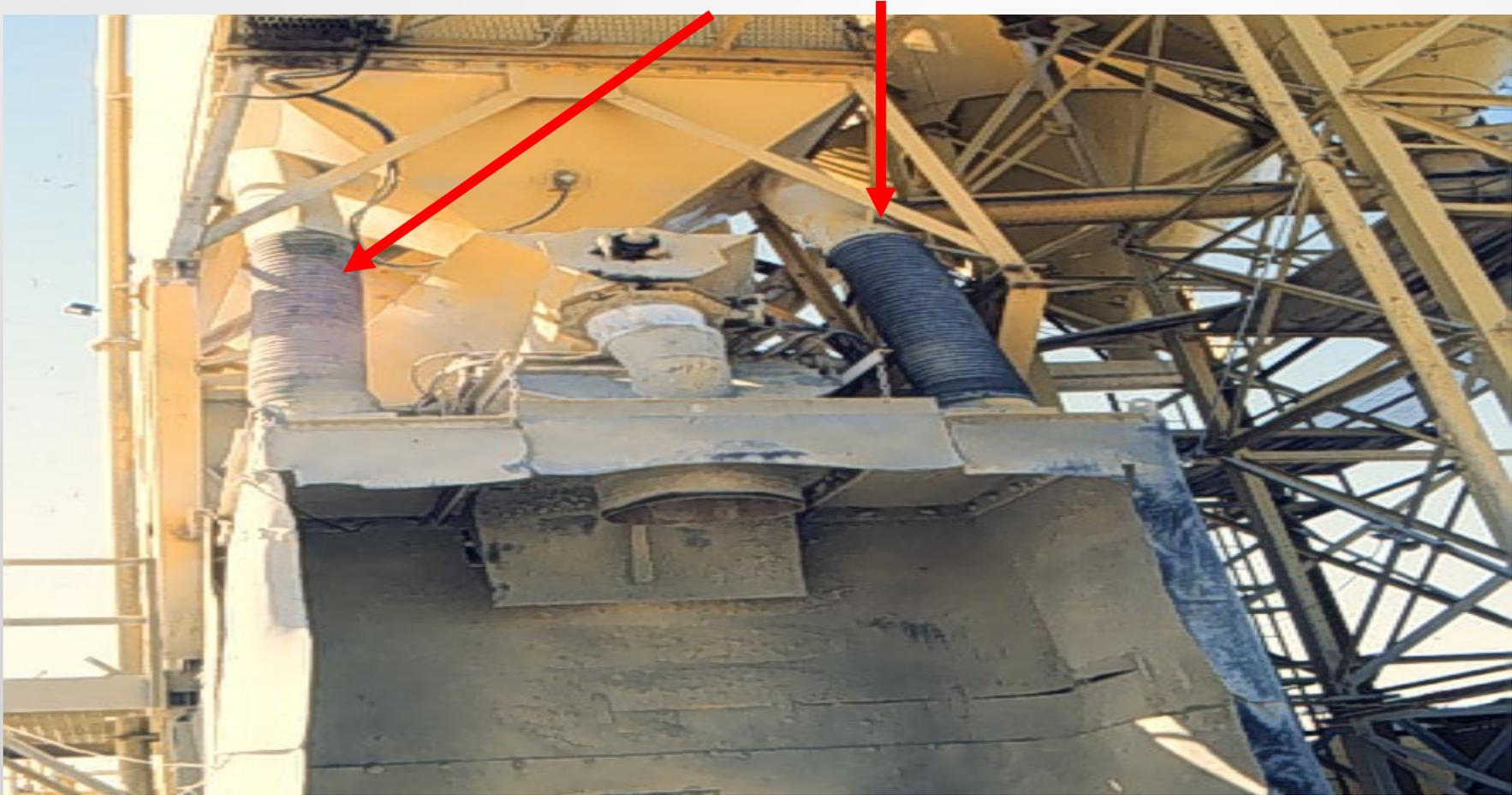
Inspection Procedures: Water Spray/Enclosures



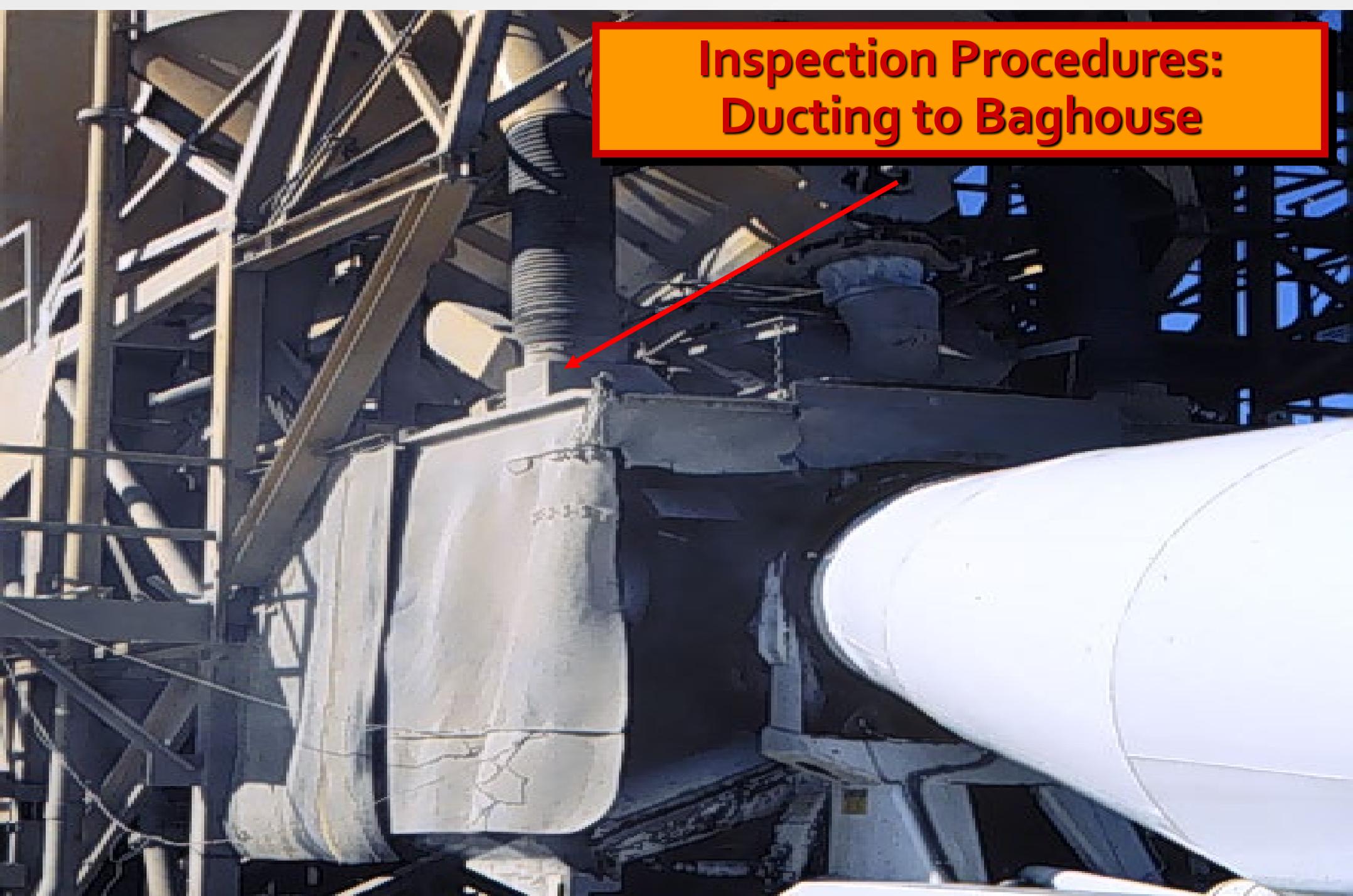
Inspection Procedures: Load out

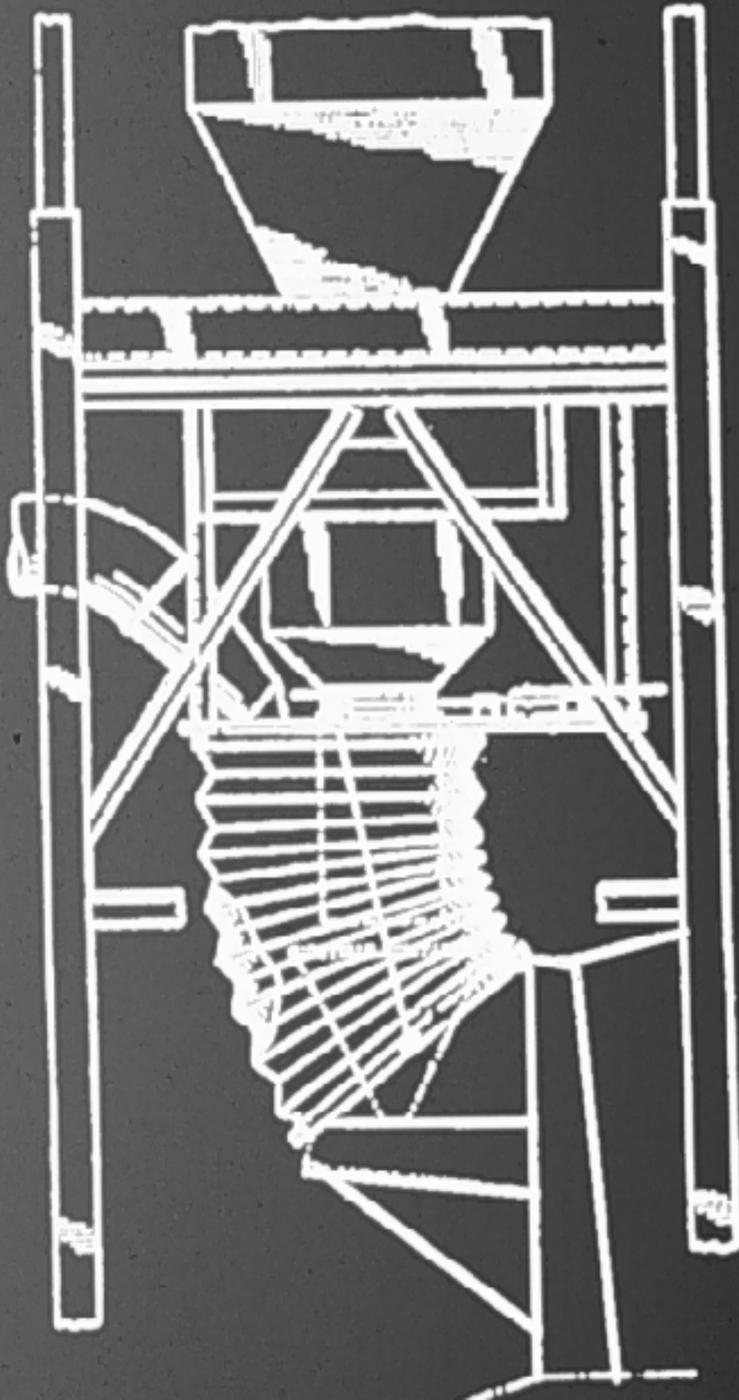


Inspection Procedures: Ducting to Baghouse



Inspection Procedures: Ducting to Baghouse



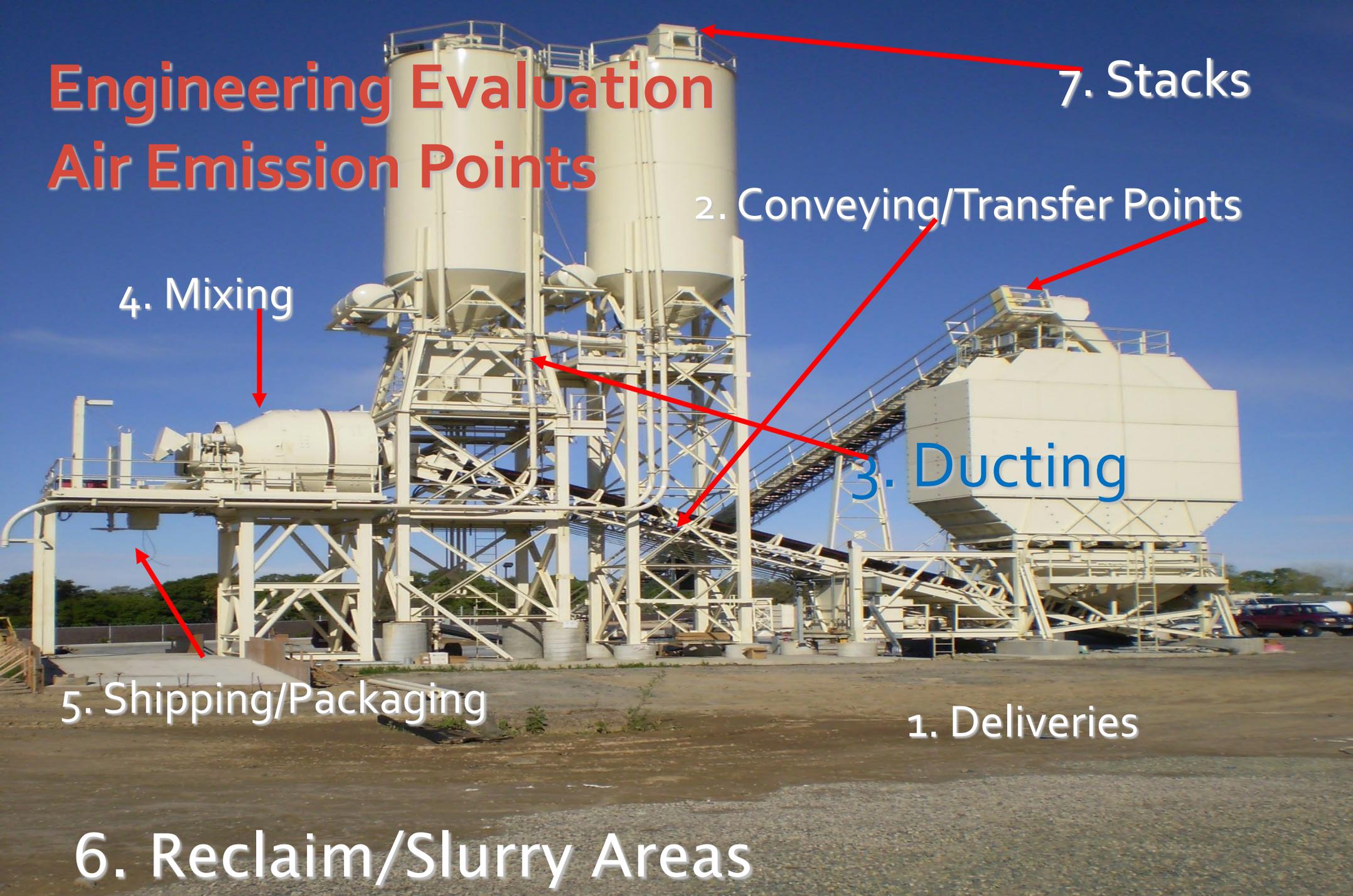


**Inspection Procedures:
Flexible Shroud**

Inspection Procedures: Flexible Shroud



Engineering Evaluation Air Emission Points



7. Stacks

2. Conveying/Transfer Points

4. Mixing

3. Ducting

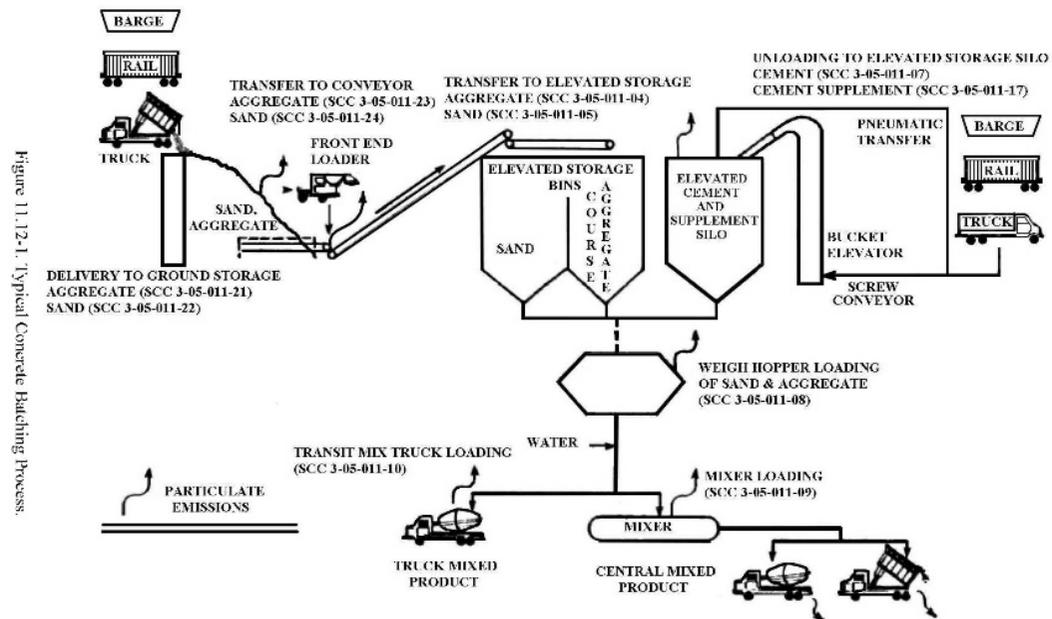
5. Shipping/Packaging

1. Deliveries

6. Reclaim/Slurry Areas

Engineering Evaluation Typical Process With AP-42 Emission Factors

6/06



11.12-3

**Engineering Evaluation:
Composition of 1 Cubic Yard of Concrete
(from AP-42)**

Material	Composition by Weight (lbs/yd³)
Coarse Aggregate	1865
Sand	1428
Cement	491
Cement Supplement	73
Water	20 gallons
Total Quantity Concrete Produced	4024

Engineering Evaluation: Site Specific Emission Factor Truck Mix and Central Mix Loading*

$$E = k(0.0032) \frac{U^a}{M^b} + c$$



E = Emission factor in lbs/ton of cement and cement supplements

k = Particle size multiplier (dimensionless)

U = Wind speed at the material drop point (mph)

M = Minimum moisture (% by weight) of cement and cement supplement

a,b = Exponents

c = Constant

* (Equation 11.12-1 from Chapter 11.12 of AP-42), use Tables 11.2-3 or Table 11.2-4 for values of k, a, b and c

Engineering Evaluation: PM Emissions from 1 Cubic Yard of Concrete (from AP-42)

Total PM* equation

Total PM emissions

$$\left(\frac{\text{pounds}}{\text{yd}^3 \text{ of concrete}} \right) =$$

0.282 times factor from Equation 11.12-1 or Table 11.12-2

*Total PM= PM, PM₁₀, PM_{10-2.5}, PM_{2.5}

Equation 11.12-2 from Chapter 11.12 of AP-42

Engineering Evaluation: Unpaved Industrial Roads (added to emissions from storage piles & represent national average values)

$$E = k(s/12)^a(W/3)^b[(365-P)/365] \text{ in lb/VMT}$$

Where:

E=Emission Factor (lb/VMT)

k=Particle size multiplier (dimensionless); PM10 k=1.5

s=Silt content of road surface (%); 5-10% typical but varies widely

W=Mean vehicle weight (tons); 25 tons typical but can vary

P=Number of days with greater than or equal to 0.01 inches of precipitation per year; ~50 days in SW, over 100 elsewhere

AP-42 5th Ed. Section 13.2.2, Equation 1a

Table 13.2.2-2. - Constants For Equations 1a and 1b, Figure 13.2.2-1 for rainfall

Engineering Evaluation: Emissions from Storage Piles

- Loading into/from Storage Piles

- AP-42, Section 13.2.4, Eq. 1

$$E(\text{lb/ton}) = k (0.0032) (U/5)^{1.3} / (M/2)^{1.4}$$

- k = particle size multiplier (dimensionless)
 - U = mean wind speed (mph)
 - M = material moisture content (%)

- Wind Erosion of Storage Piles

- AP-42, Section 13.2.5, Eq. 1

$$E (\text{g/m}^2/\text{yr}) = \sum_{i=1}^N P_i$$

- Need friction velocity of piles, pile size and shape, disturbance frequency, wind speed data, etc.



Engineering Evaluation: Emissions Characterization



1. Only the transfer points of cement and cement supplement into the storage silos are point source
 - Storage silos abated by fabric filter, baghouse or binvent filter

Engineering Evaluation: Emissions Characterization

2. Transfer of sand & aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from sand and aggregate storage piles
 - Water sprays, enclosures, and baghouse devices and good housekeeping, maintenance and wetting of unpaved surfaces



Engineering Evaluation: Dust Collection and Control Systems



Baghouses are regulated in terms of

1. Grains/dry standard cubic foot of air emitted or
2. Pounds/ton of aggregate produced
3. Opacity

Engineering Evaluation: Dust Control Efficiency

- $IDL - ODL / IDL \times 100 = CE$

Where:

- IDL = inlet dust loading
- ODL = outlet dust loading
- CE = control efficiency
- Units = Grains/dry standard cubic foot



Baghouse

Inspection Objectives & Safety

- Determine compliance with District, Federal regulations & permit conditions
- Fugitive emissions
- Dust Collector emissions
- Visible emissions tests
- General Maintenance
- Records & logs
- Corrective actions





Dust Emissions?



Thank You

