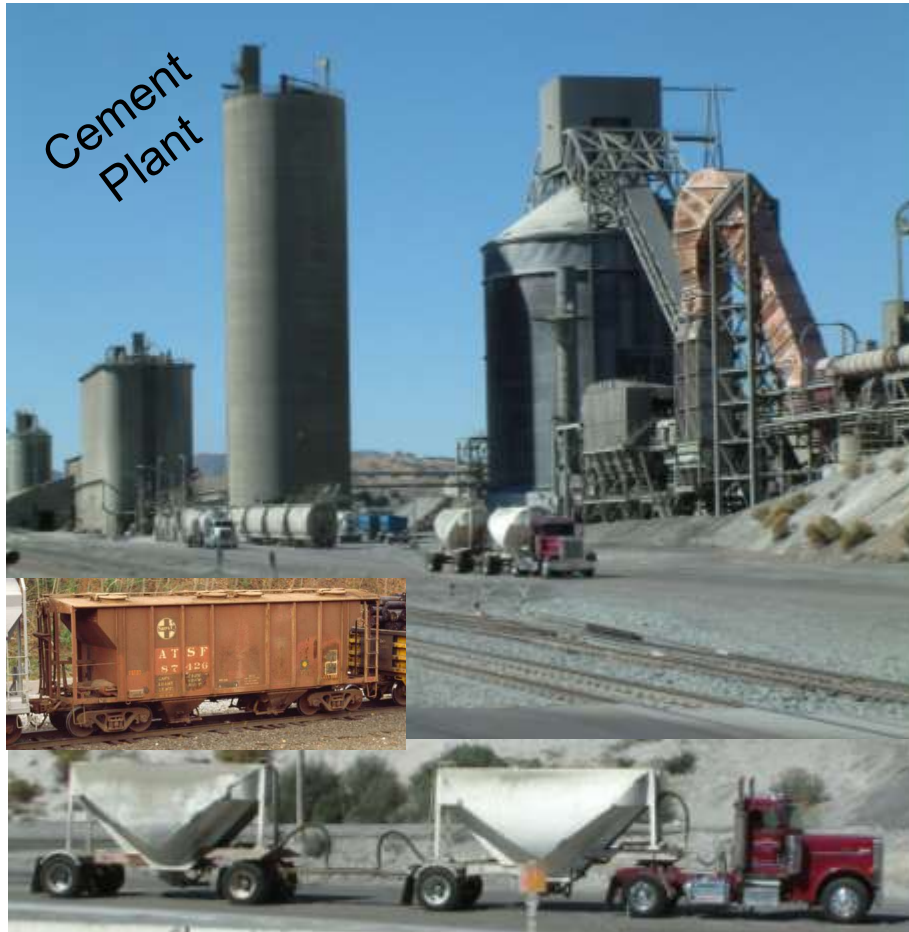


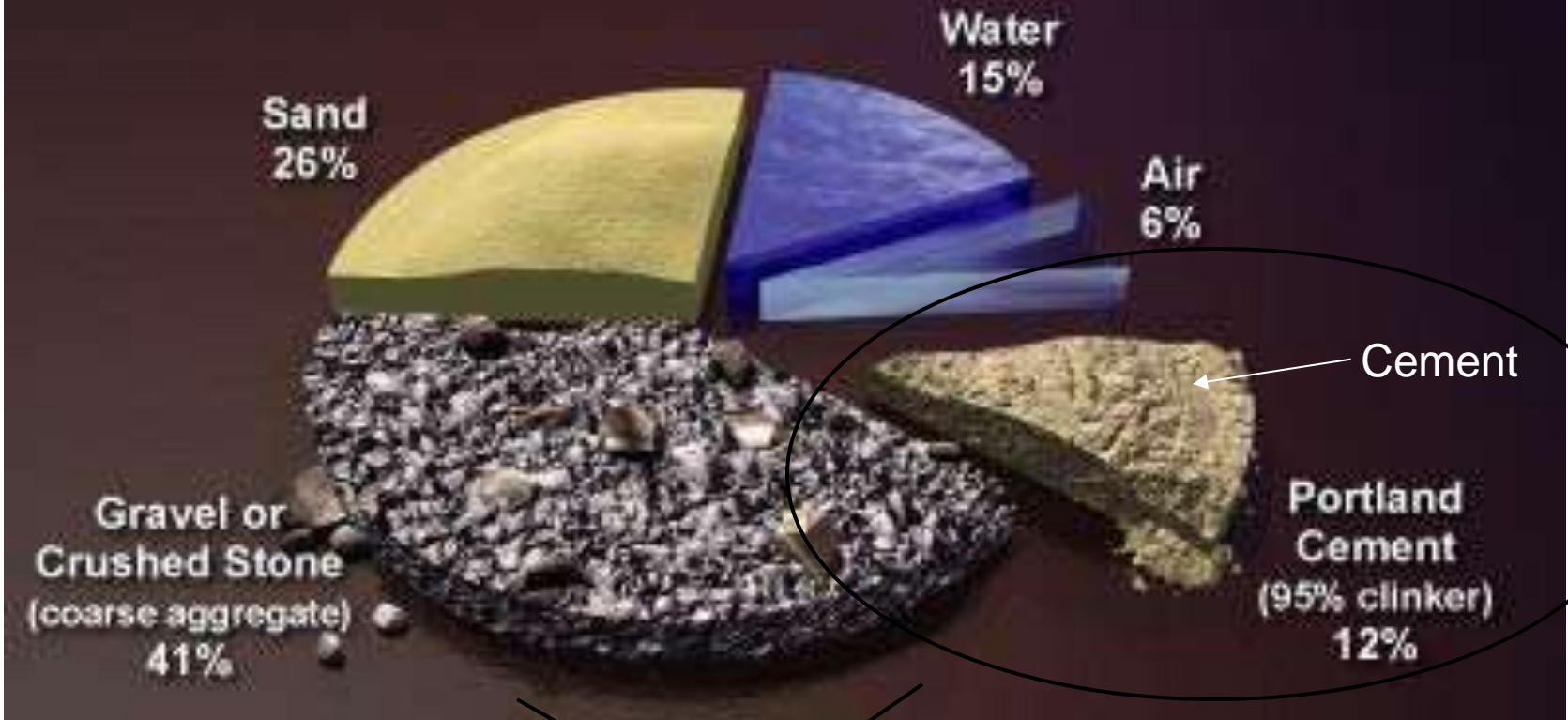
# Cement vs. Concrete

How to model these different, but related industries on your model railroad



By: Ken Edmier

# A Typical Concrete Mix



← Concrete →



# How Cement is Made

- 1 Quarry
- 2 Proportioning, Blending, & Grinding
- 3 Preheater Tower
- 4 Kiln
- 5 Clinker Cooler & Finish Grinding
- 6 Bagging & Shipping

*For its raw materials, cement uses minerals containing the four essential elements for its creation: calcium, silicon, aluminum, and iron.*



## Quarry

An interactive digital interface for the 'Quarry' stage. The background is a photograph of a rocky quarry. In the foreground, four 3D-style element cards are displayed. Each card shows the atomic number, symbol, name, and atomic weight of an element. Below the cards is a navigation bar with buttons for 'Basic Elements', 'Raw Materials', 'Crusher', and 'Animate'.

Atomic Number	Symbol	Name	Atomic Weight
20	Ca	Calcium	40.08
14	Si	Silicon	28.086
13	Al	Aluminum	26.9815
26	Fe	Iron	55.847

**Cement**  
Making *Process*

1 Quarry

2 Proportioning, Blending, & Grinding

3 Preheater Tower

4 Kiln

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6 Bagging & Shipping

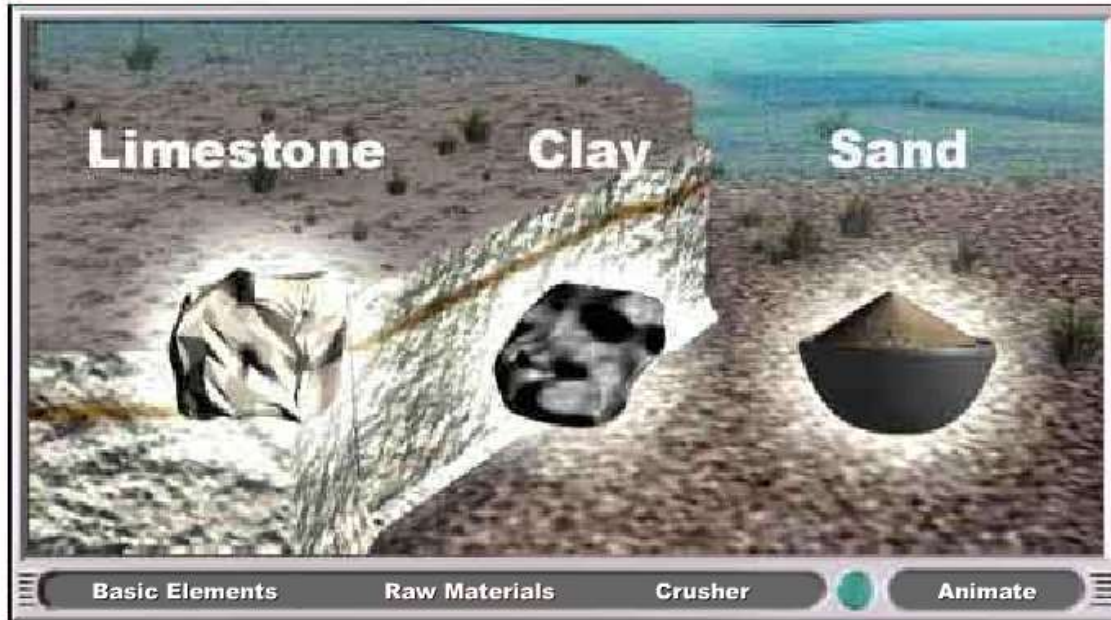


*Most plants rely on a nearby quarry for limestone. The most common combination of ingredients*

*is limestone (for calcium) coupled with much smaller quantities of clay and sand (as sources of silica, aluminum, and iron).*

*Other raw materials, such as mill scale, shale, bauxite and fly ash, are brought in from outside sources when necessary.*

## Quarry



**Cement**  
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Rock blasted from the quarry face is transported to the primary crusher, where chair sized rocks are broken into pieces the size of baseballs. A secondary crusher reduces them to the size of gravel. Some plants now crush materials in a single stage.

## Quarry



**Cement**  
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*The raw materials are now analyzed in the plant laboratory, blended in the proper proportion, and then ground even finer.*

## Proportioning, Blending & Grinding



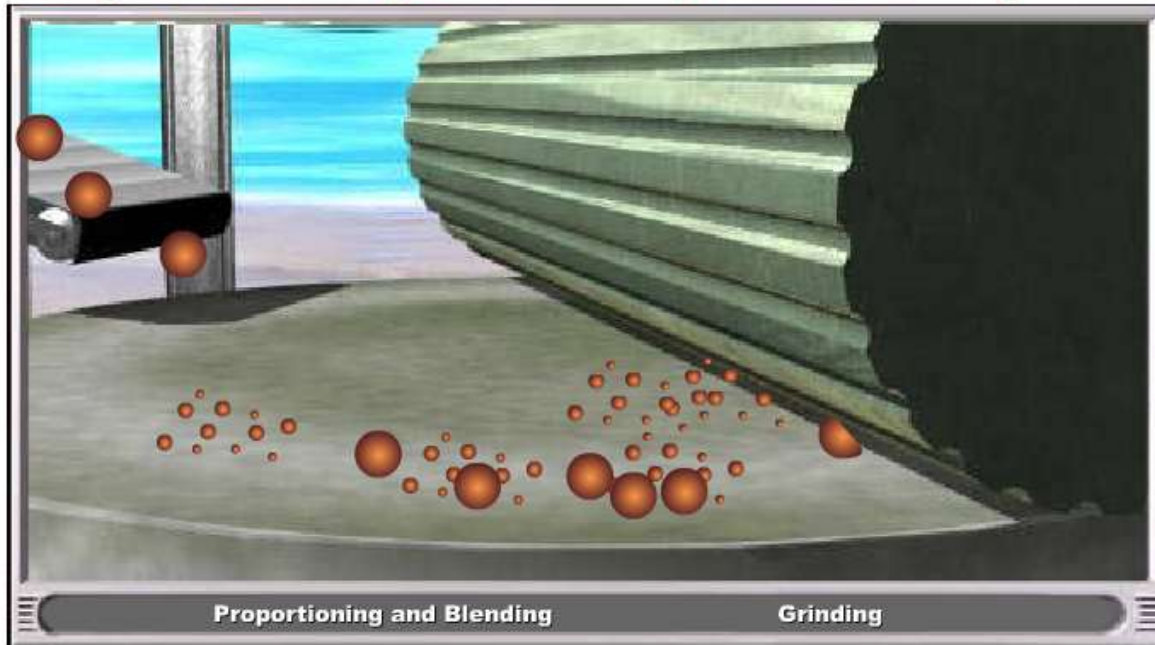
**Cement**  
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*Plants grind the raw materials with heavy, wheel-type rollers that crush the materials into powder against a rotating table. After grinding, the material is now ready for the kiln or preheater, depending on plant type.*

## Proportioning, Blending & Grinding



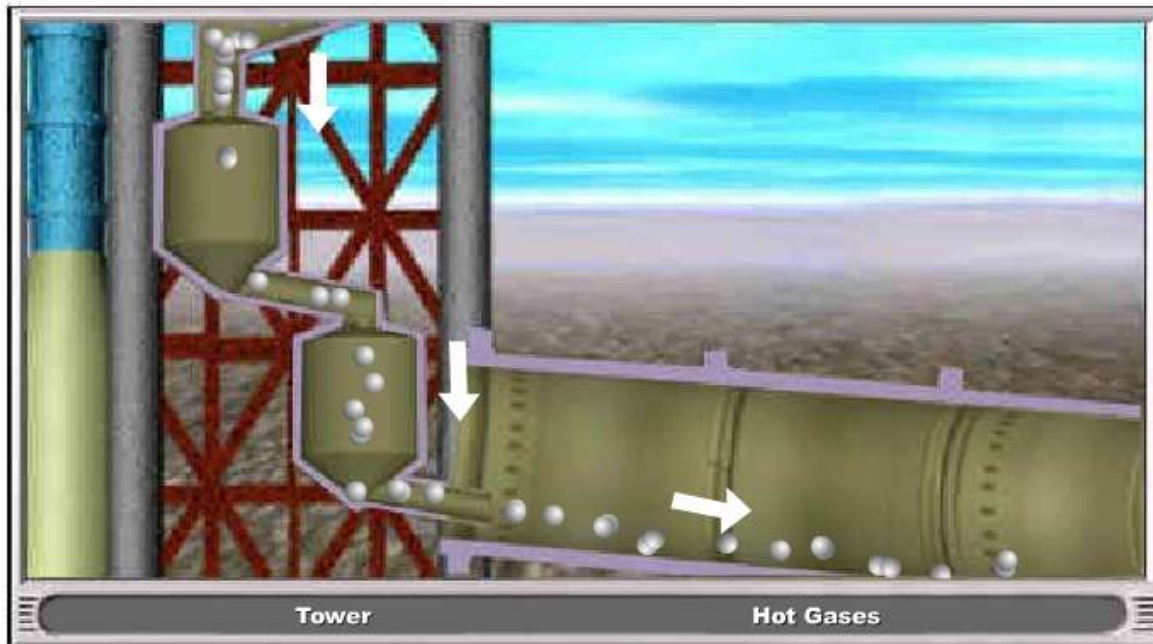
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*The preheater tower supports a series of vertical cyclone chambers through which the raw materials pass on their way to the kiln.*

## Preheater Tower



**Cement**  
Making *Process*

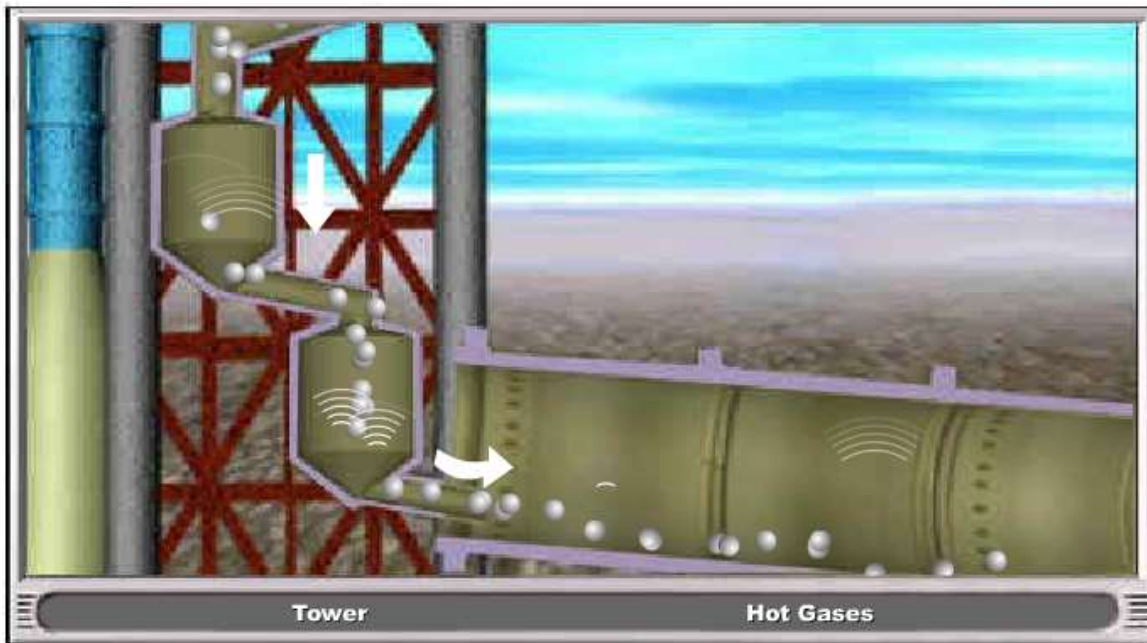


- 1 Quarry
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*To save energy, modern cement plants preheat the materials before they enter the kiln. Rising more than 200 feet, hot exit gases from the kiln heat the raw materials as they swirl through the cyclones.*

## Preheater Tower



**Cement**  
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*Raw materials now enter the huge rotating furnace called a kiln. It's the heart of the cement-making process — a horizontally sloped steel cylinder, lined with firebrick, turning from about one to three revolutions per minute. The kiln is the world's largest piece of moving industrial equipment.*

## Kiln



**Cement**  
Making *Process*

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*From the preheater, the raw material enters the kiln at the upper end. It slides and tumbles down the kiln through progressively hotter zones toward the flame. At the lower end of the kiln, fuels such as powdered coal and natural gas feed a flame that reaches 3400 °F (1870 °C) — one-third of the temperature of the sun's surface. Here in the hottest part of the kiln, the raw materials reach about 2700 °F (1480 °C) and become partially molten.*

## Kiln



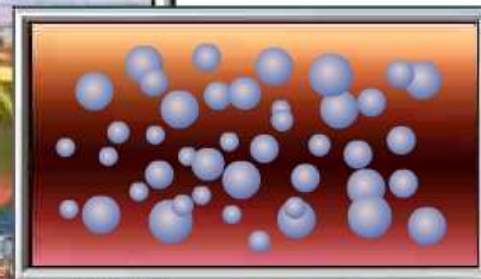
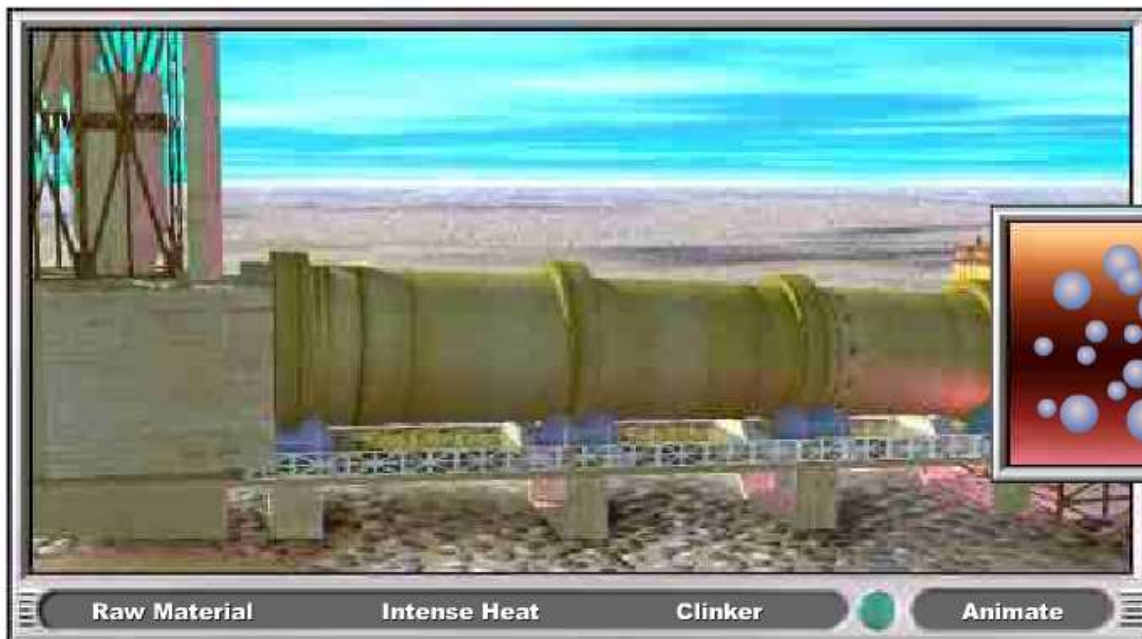
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*This intense heat triggers chemical and physical changes. Expressed at its simplest, the series of chemical reactions converts the calcium and silicon oxides into calcium silicates, cement's primary constituent. At the lower end of the kiln, the raw materials emerge as a new substance: red hot particles called clinker.*

## Kiln



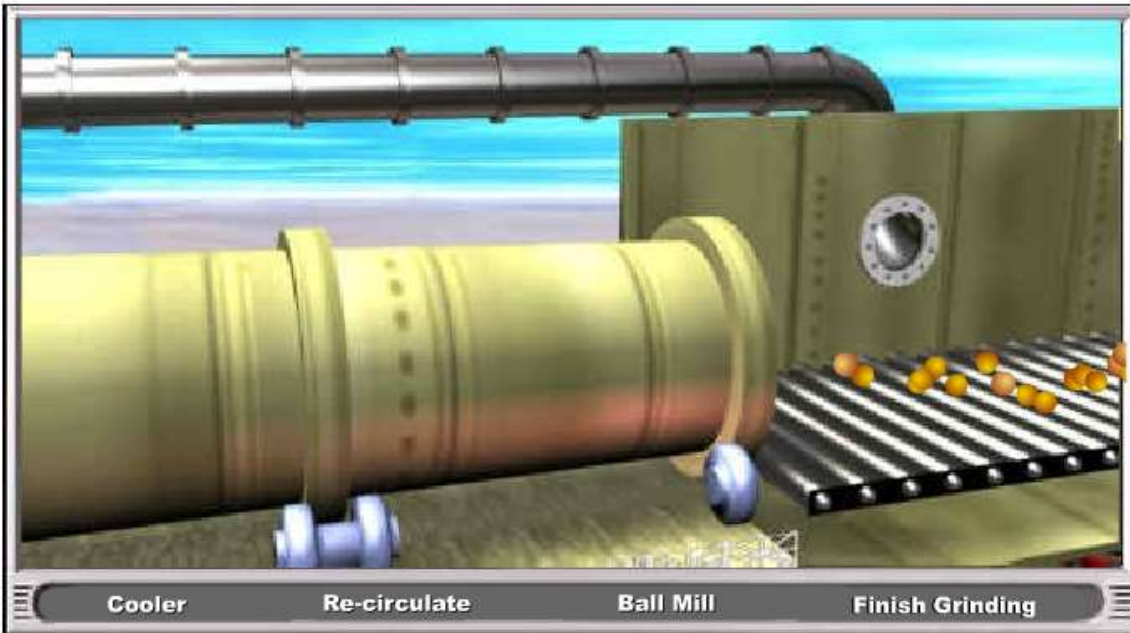
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*The clinker tumbles onto a grate cooled by forced air. Once cooled the clinker is ready to be ground into the gray powder known as portland cement.*

## Clinker Cooler & Finish Grinding



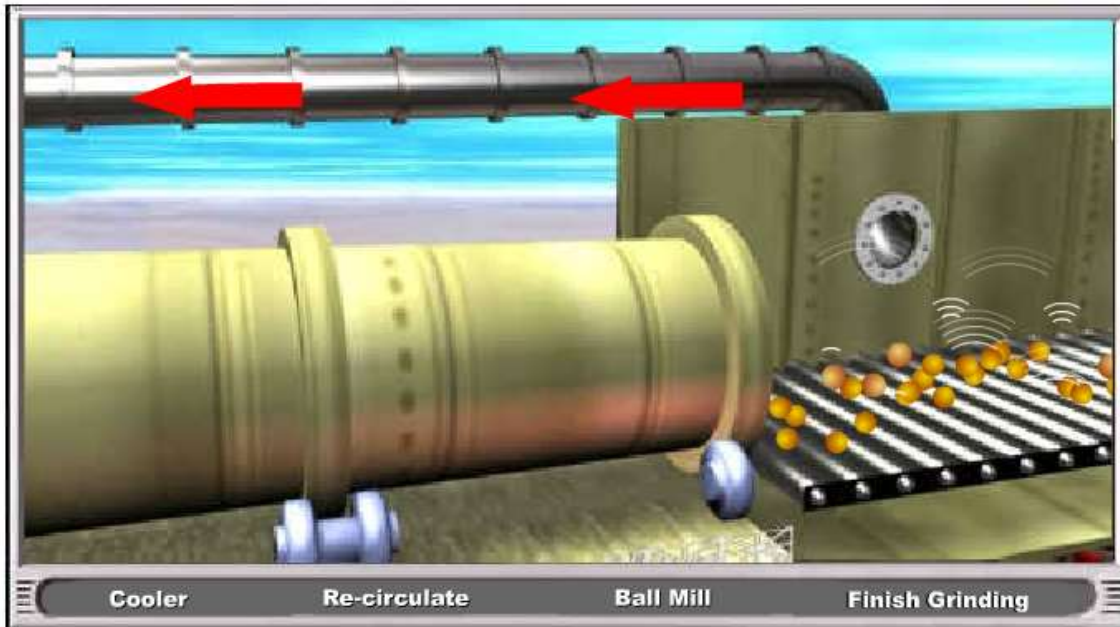
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*To save energy, heat recovered from this cooling process is recirculated back to the kiln or preheater tower.*

## Clinker Cooler & Finish Grinding



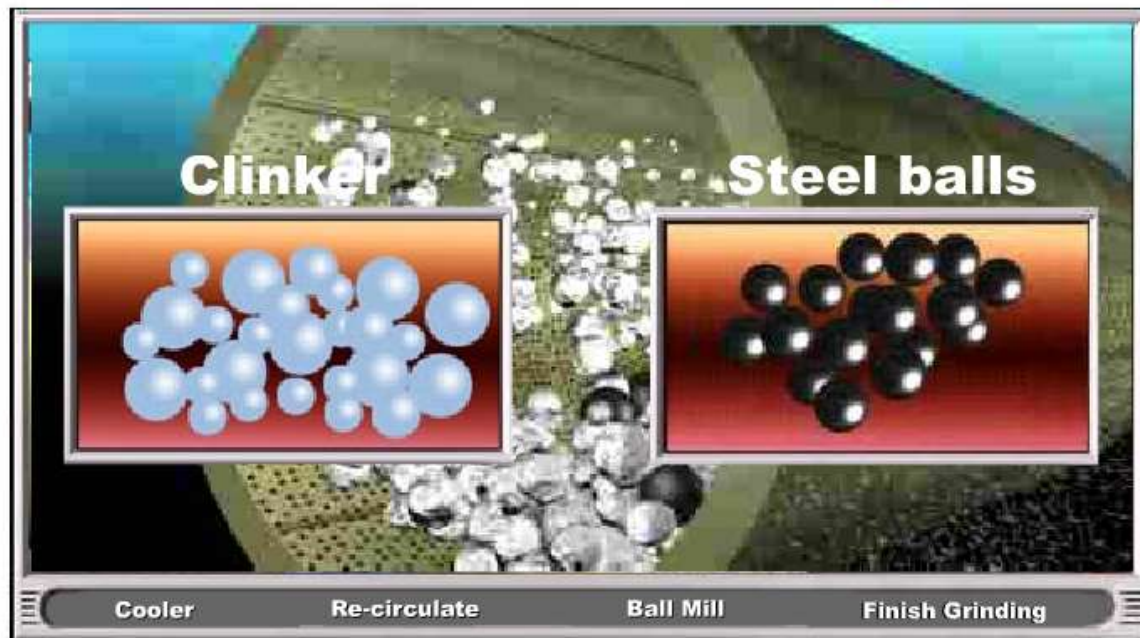
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The clinker is ground in a ball mill — a horizontal steel tube filled with steel balls. As the tube rotates, the steel balls tumble and crush the clinker into a super-fine powder. It can now be considered portland cement. The cement is so fine it will easily pass through a sieve that is fine enough to hold water. A small amount of gypsum is added during final grinding to control the set.

## Clinker Cooler & Finish Grinding



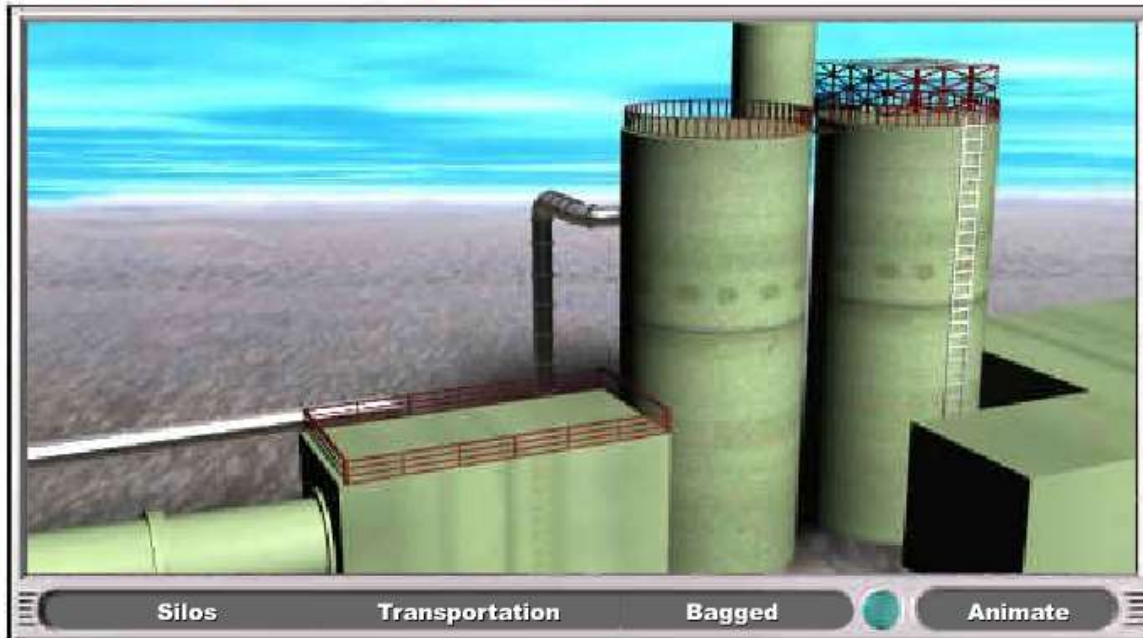
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*From the grinding mills, the cement is conveyed to silos where it awaits shipment.*

## Bagging & Shipping



**Cement**  
Making *Process*



Pacific Portland Cement Company – Bay Area, CA - 1928



# Florida Portland Cement Company – around 1930



# Florida Portland Cement Company – around 1930



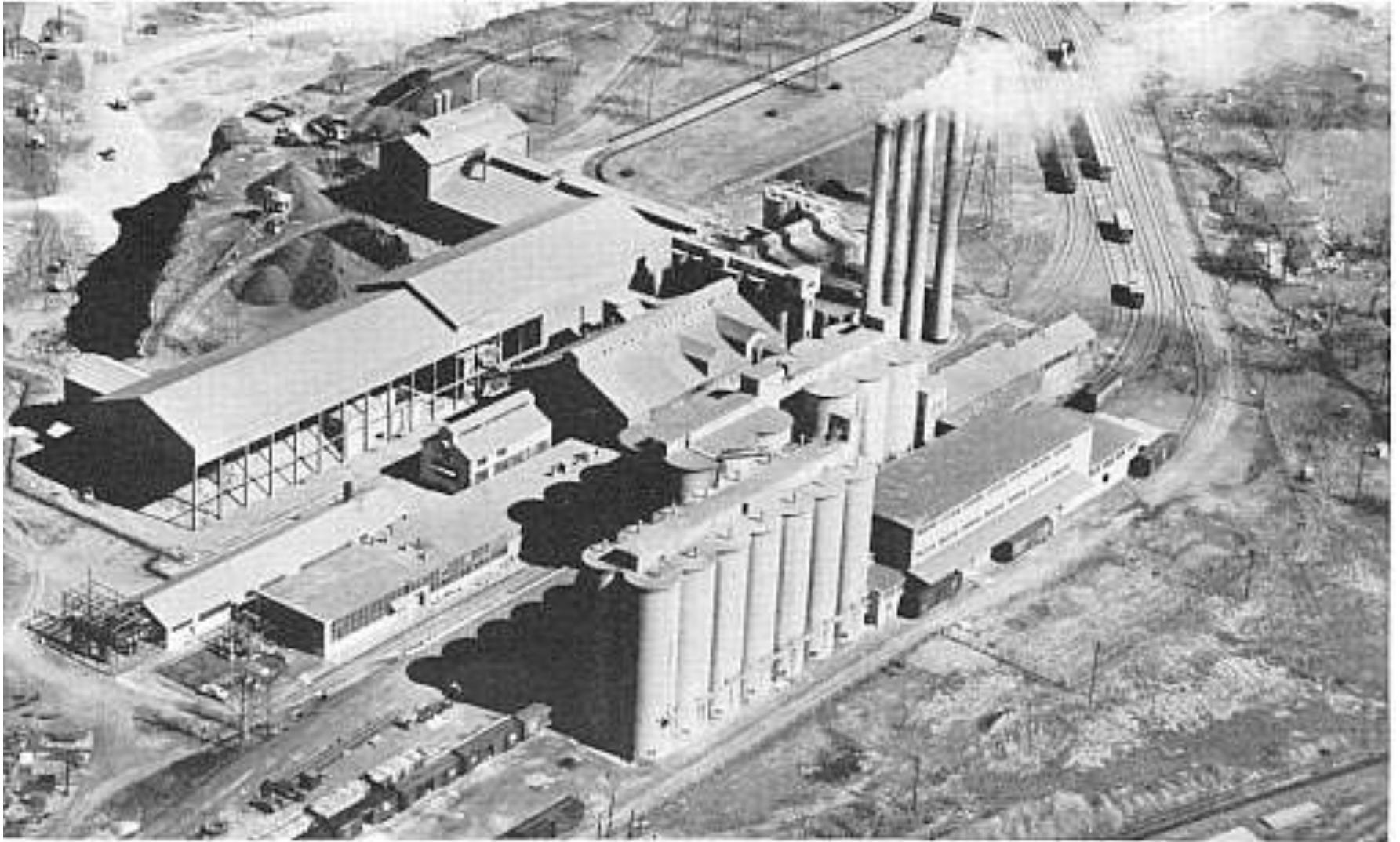
# Florida Portland Cement Company – around 1930

For information or reproductions, contact the Tampa-Hillsborough County Public Library.



Courtesy, Tampa-Hillsborough County Public Library System

Availability of limestone deposits (left) and modern rail facilities (right) are important considerations in the location of a cement plant. North Birmingham, Ala., plant of Lone Star Cement Corporation - 1958



# Lehigh Southwest Cement

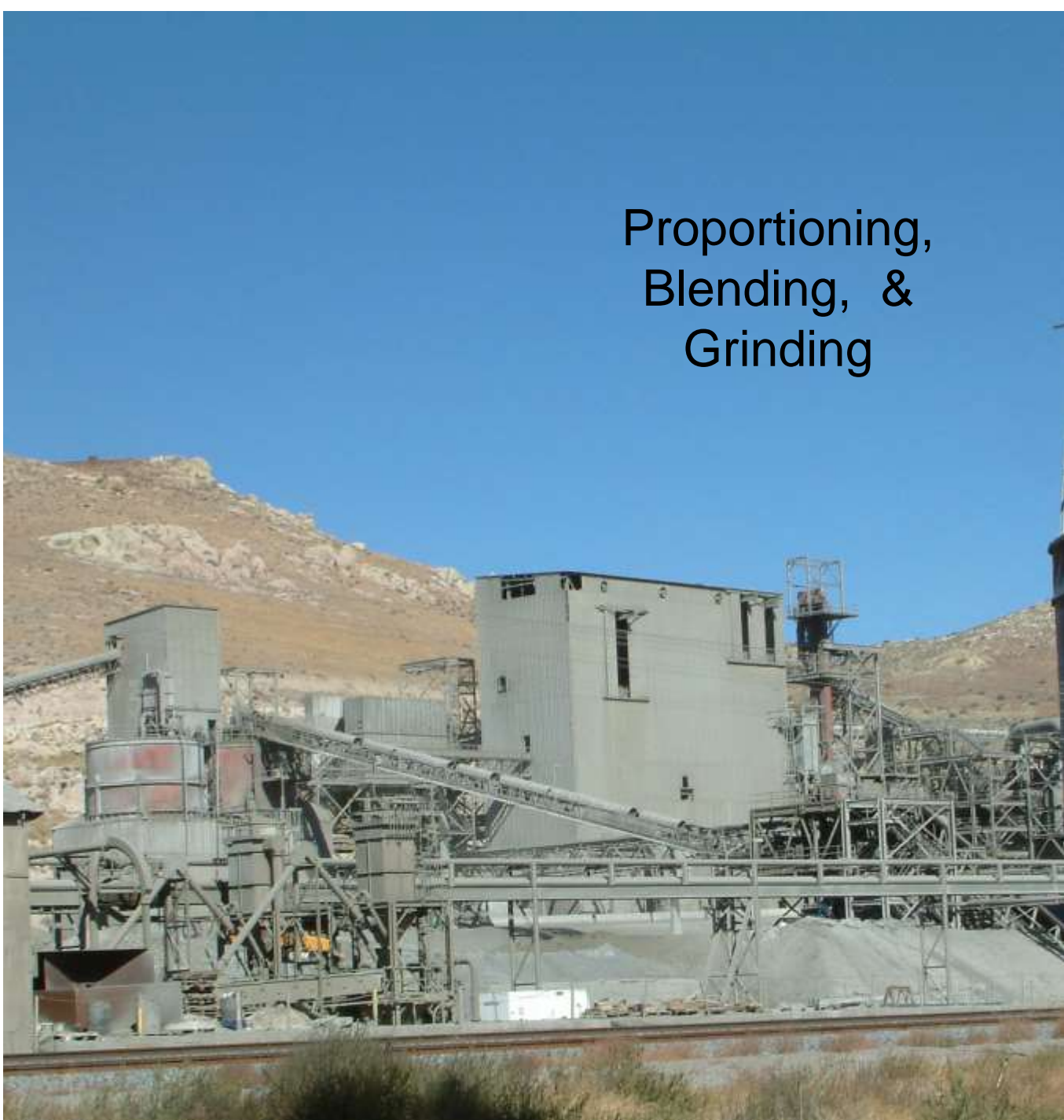
Tehachapi, CA



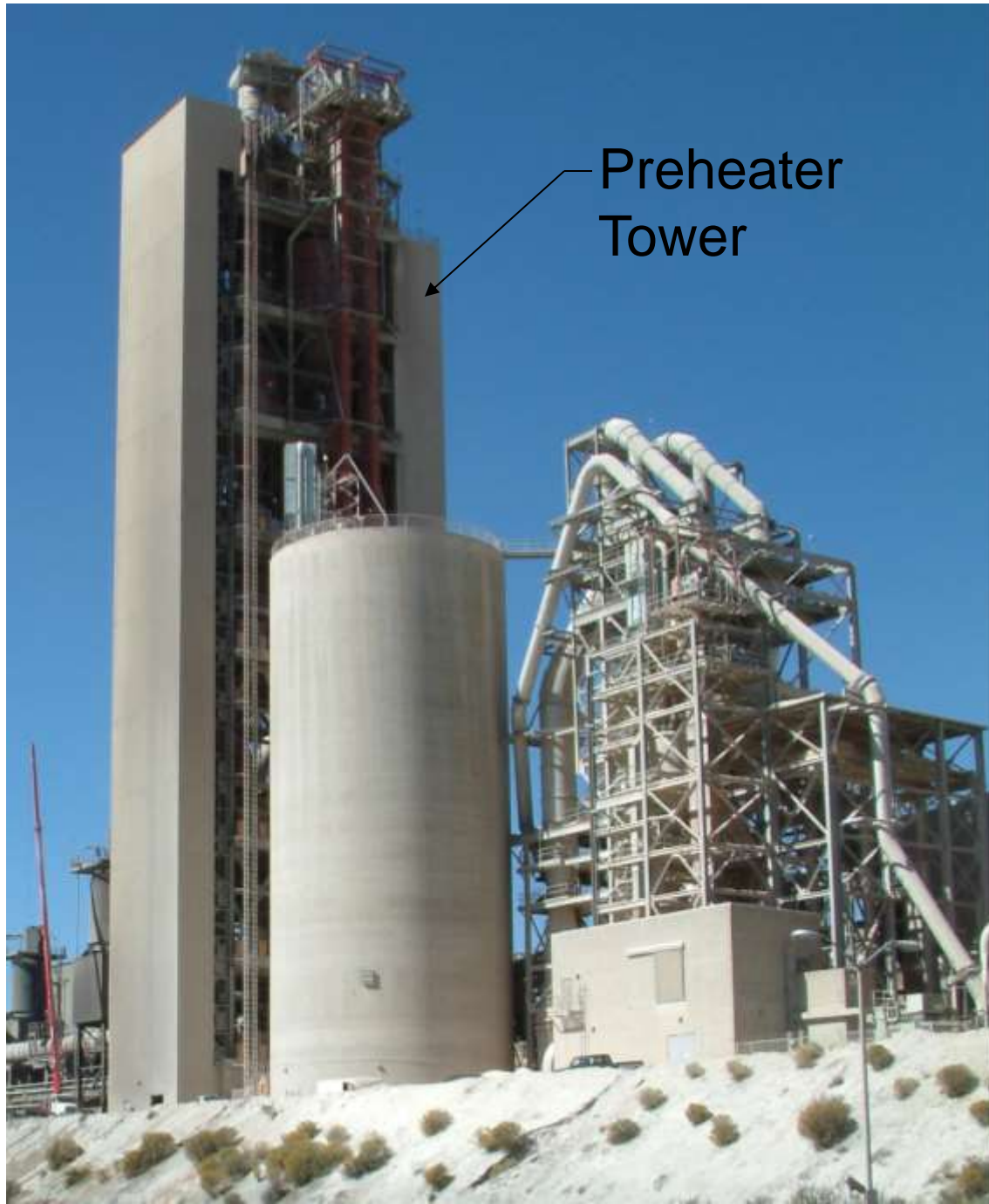
# Coal Unloading



# Proportioning, Blending, & Grinding





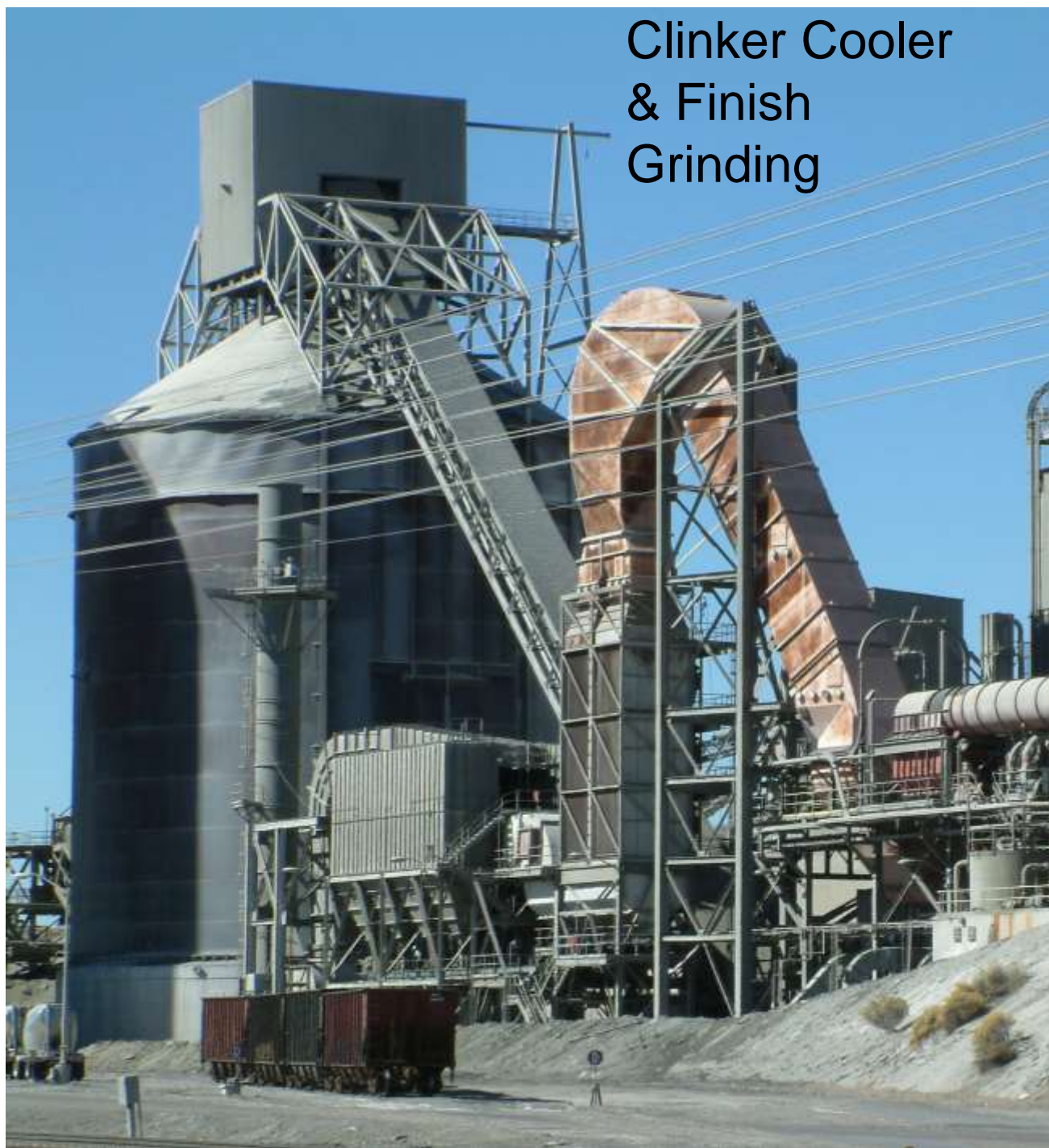


Preheater  
Tower

# Kiln



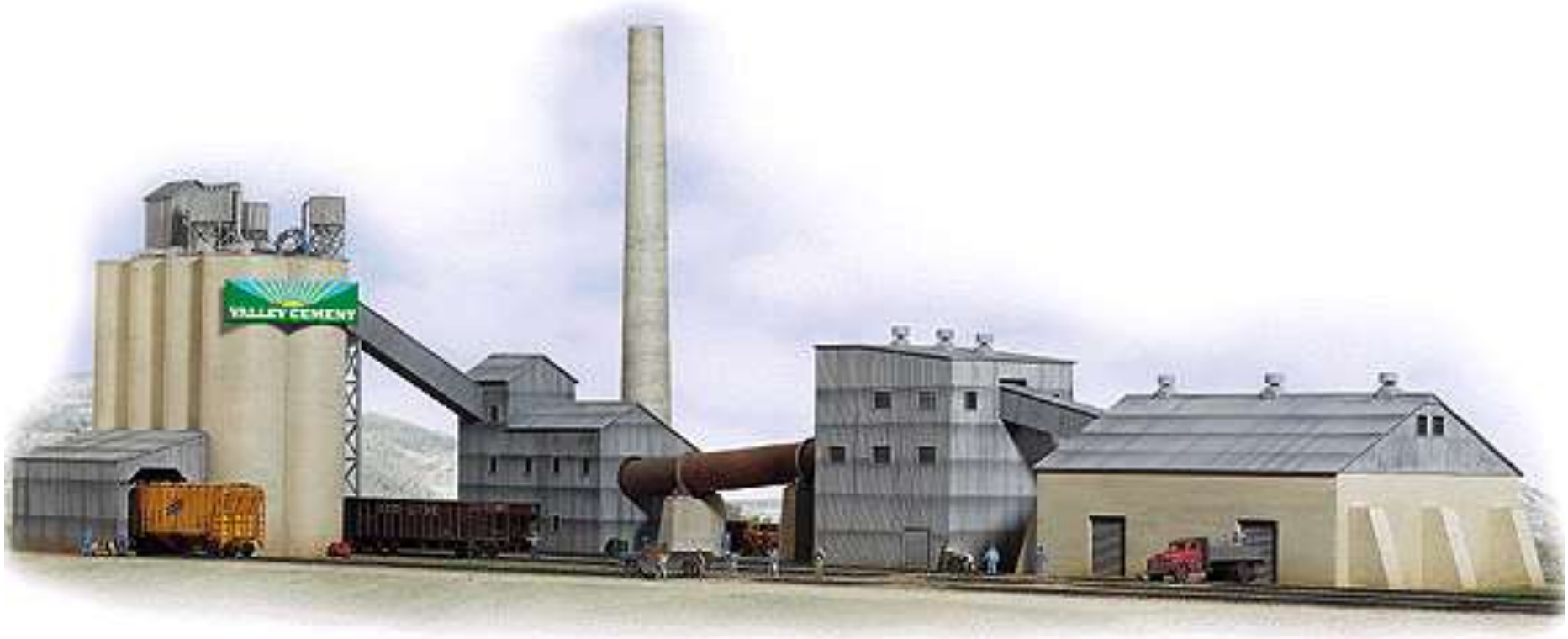
# Clinker Cooler & Finish Grinding



Cement  
Storage,  
Loading,  
&  
Bagging



# Available Models:



Walthers Cornerstone Series(R) Valley Cement (Plastic Kit)

# Bulk Cement is shipped three ways:



By Train



By Ship

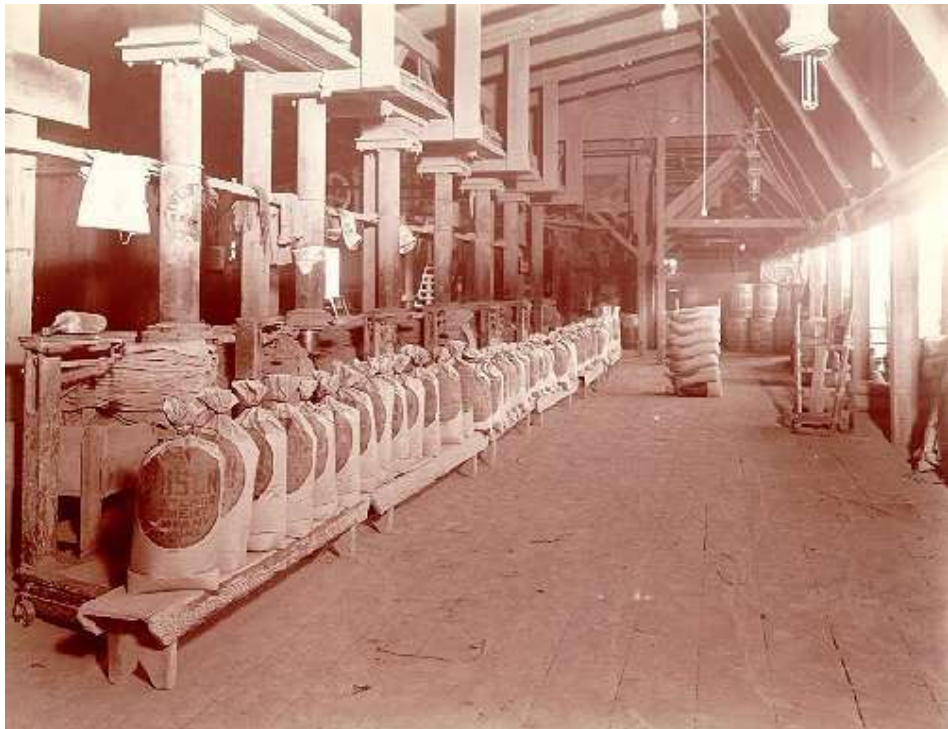
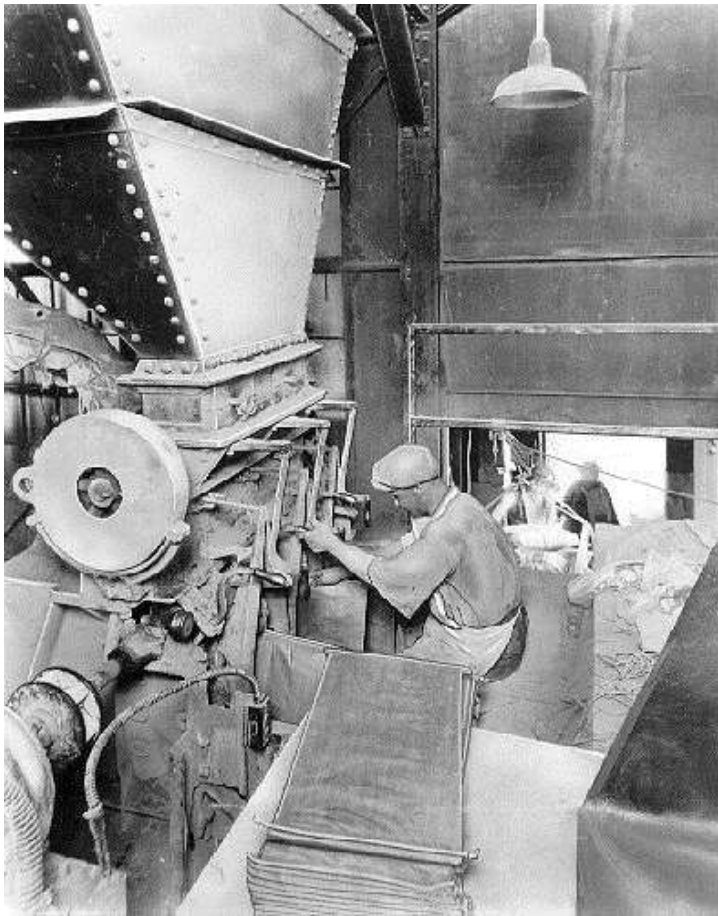


By Truck

Through the 60's, cement was shipped in bags in boxcars with Cement Plants having extensive on-site bagging plants



Caption: Automatic Bagging Machine and Car Loading Conveyor; New Village, NJ -1941



**Bags of cement being neatly stacked in a box car  
Southern Cement Company's Roberta, Ala., plant. 1958**





After WWII, covered hoppers started carrying the cement directly to the Concrete Plants.

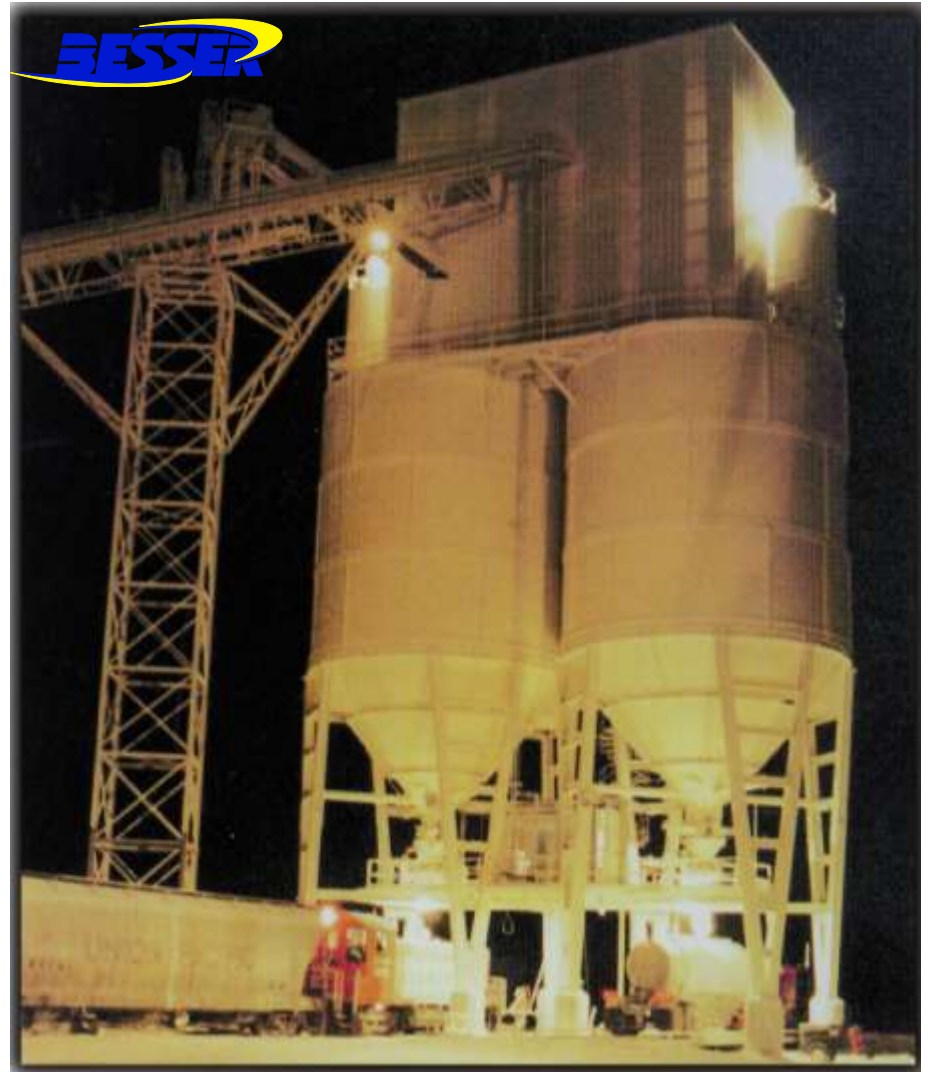


Covered hopper cars loaded at Marquette Cement Manufacturing Company, Rockmart, GA, 1958

Loading bulk cement into a covered hopper car at  
The Universal Atlas Cement Company, Leeds, Ala - 1958



# Modern Rail loading silos



Before the 1960's, most railcars went directly to the end user.

# Freight Cars used for hauling cement, typically 2-Bay Covered Hoppers



Pullman-Standard PS2,  
Models by Kadee and  
Atlas, first built in 1952.

ACF Hi-Cube  
Centerflow, New  
models by  
Athearn, first  
built in 1966





**North American PD3000 by Rail Yard Models  
1970 to present**





Trinity 2-Bay,  
3,000 cf, Models  
by Walthers, first  
built in the early  
90's

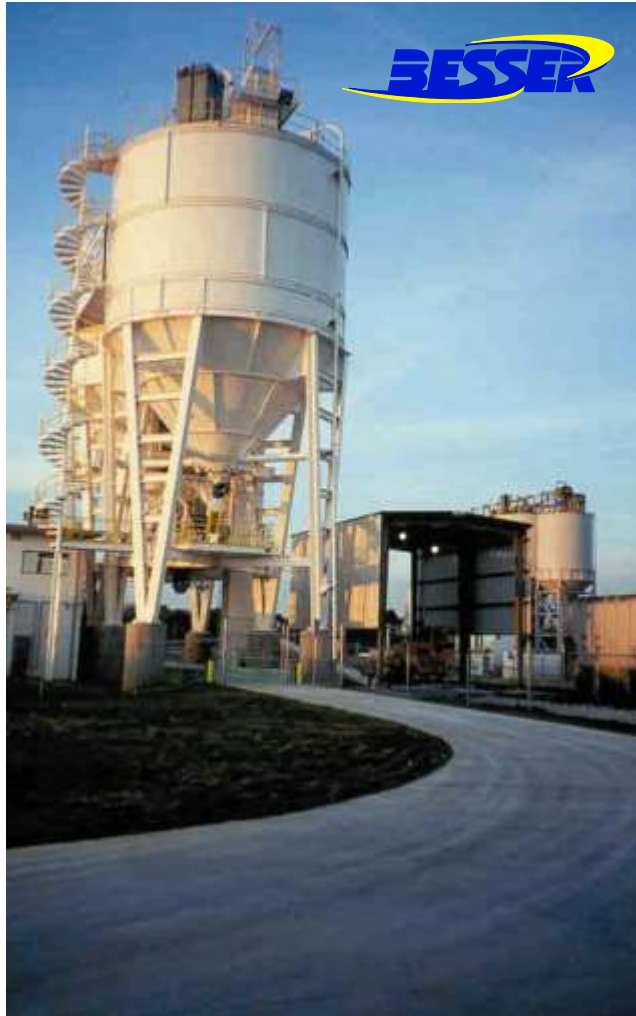


© 1994 Darrell W Sawyer

First introduced in the early 1960's, the pneumatic bulker changed how cement was transported



Starting in the 1960's, most railcars arrive at Cement Terminals for storage and loading to trucks.



Instead of the cement being delivered directly to the Concrete Plant by railcar, it was transported by the pneumatic bulker from the local Cement Terminal

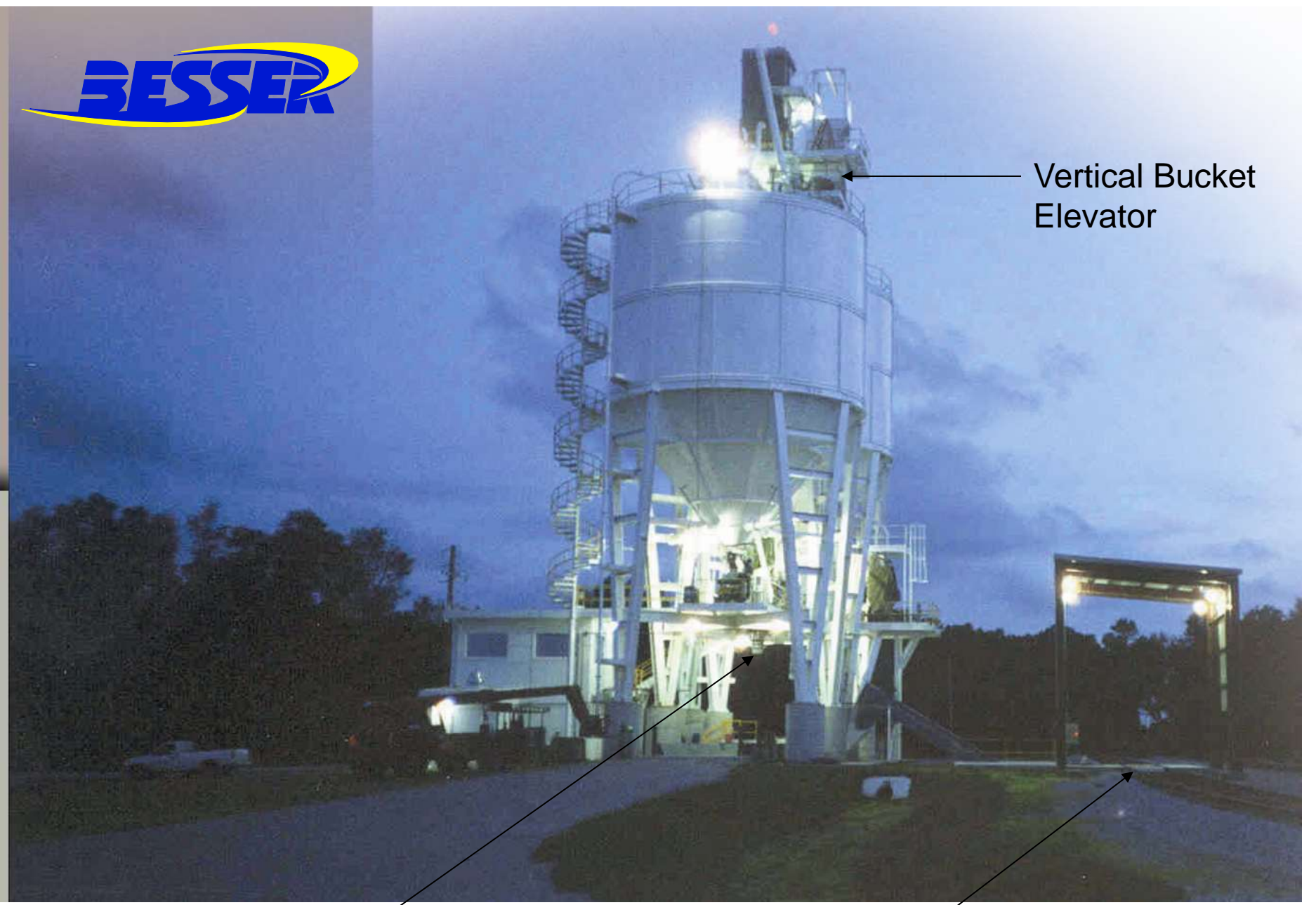




Vertical Bucket Elevator

Truck Loading

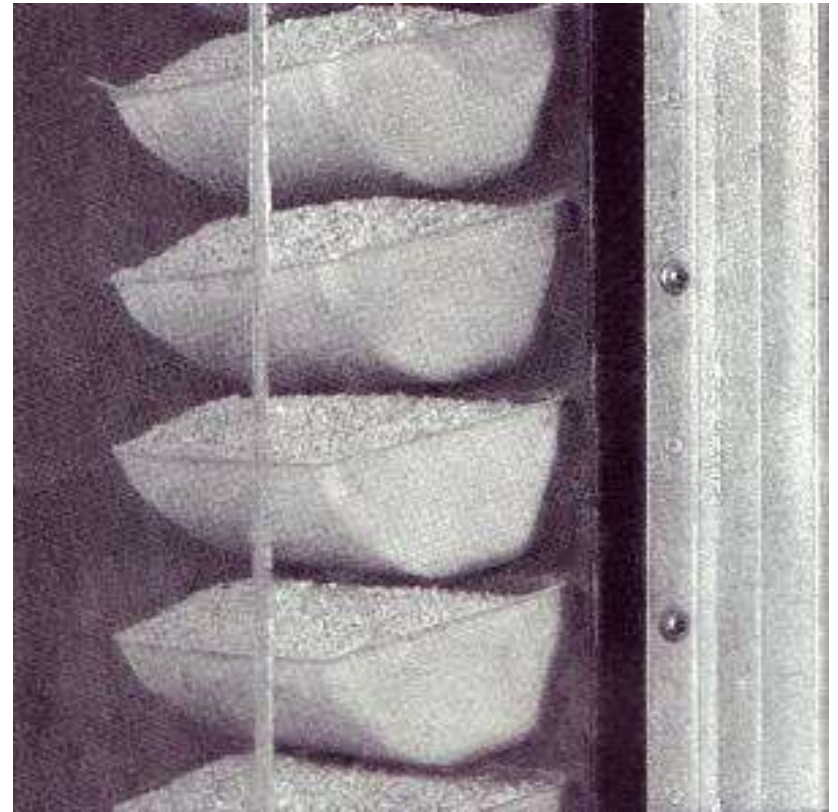
Rail Unloading



# Vertical Bucket Elevator Detail



Buckets at top emptying



Buckets on chain or belt



Available Models:

Walthers  
Cornerstone Series(R)  
Medusa Cement  
Company

Most cement is delivered to the end user by truck from either the local cement plant or local cement terminal





Single trailer with 3-bays is the most popular cement trailer today



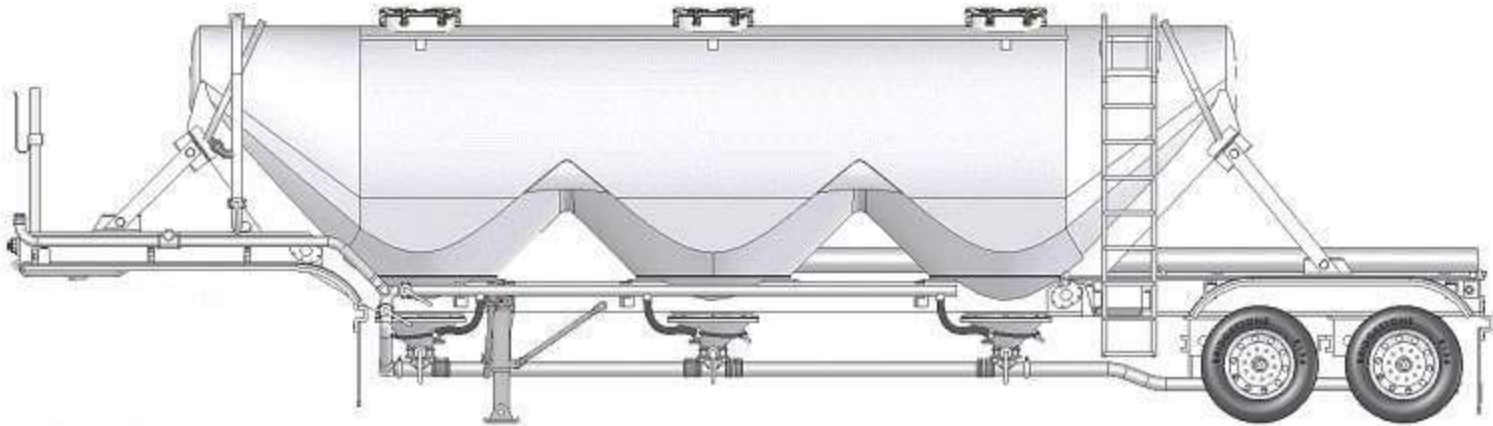
Double trailers, each with single bay are also used, very popular in California

# Available Models:

# None!



Classic Mint has announced a plated brass HO scale trailer



# Cement terminals are also served by ship



Cement terminal





# Concrete...

the most versatile building material ever developed



From dams...



...and airports



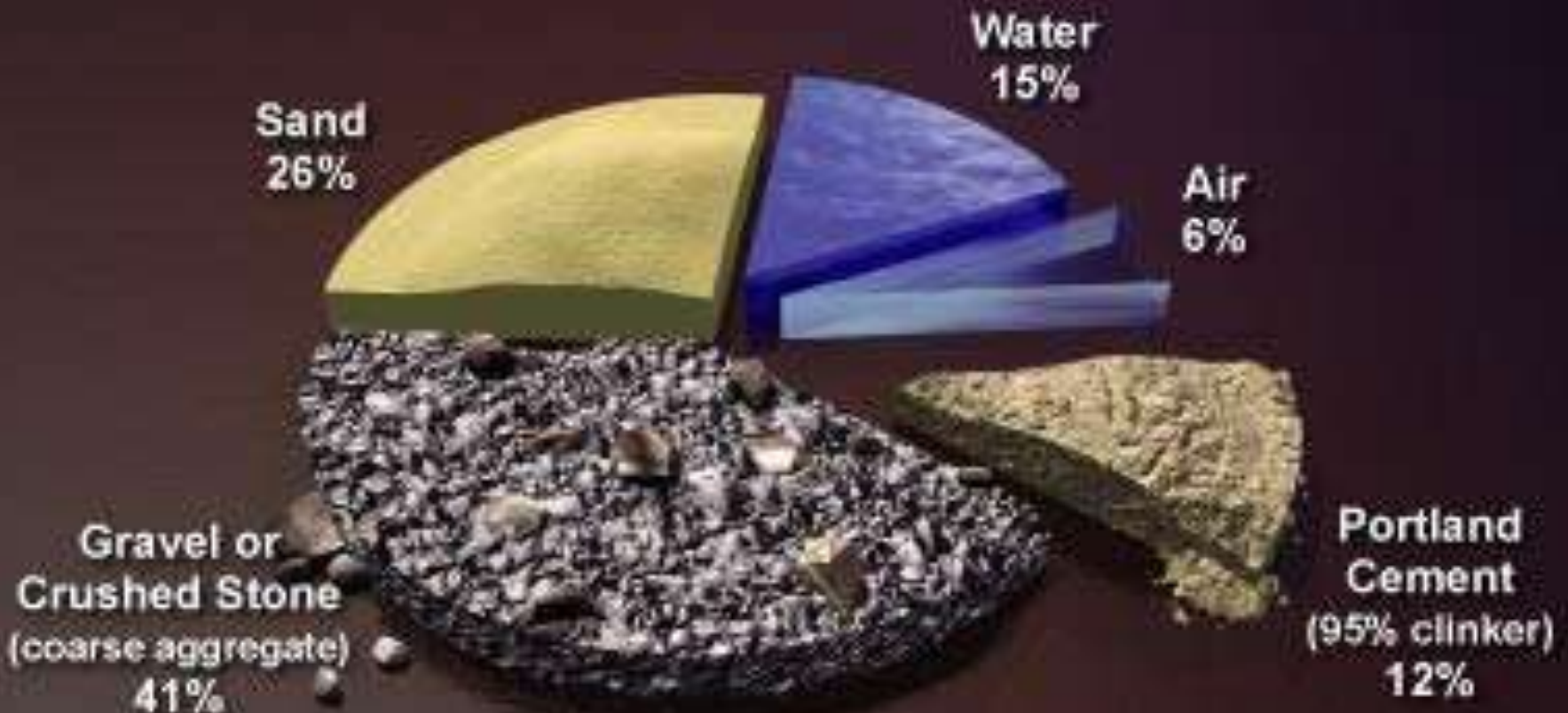
..to roadways and bridges...



...to a simple driveway

A Concrete Plant dispenses the ingredients into the Concrete Truck that then mixes the ingredients into Concrete

### A Typical Concrete Mix



# Aerial view of a typical Concrete plant



Offices & truck repair garage

Truck parking

Aggregate fill hoppers

Truck entrance/exit

Concrete Plant

Truck entrance/exit

Aggregate storage

Aggregate fill conveyor



Typical Concrete Truck

# Typical Low-profile Concrete Plant





# Plant level view



# More Low-profile Concrete Plant



# Stack-up Style Concrete Plant



Aggregate storage compartments

Cement compartments

Truck loading position



# Stack-up Style Concrete Plant



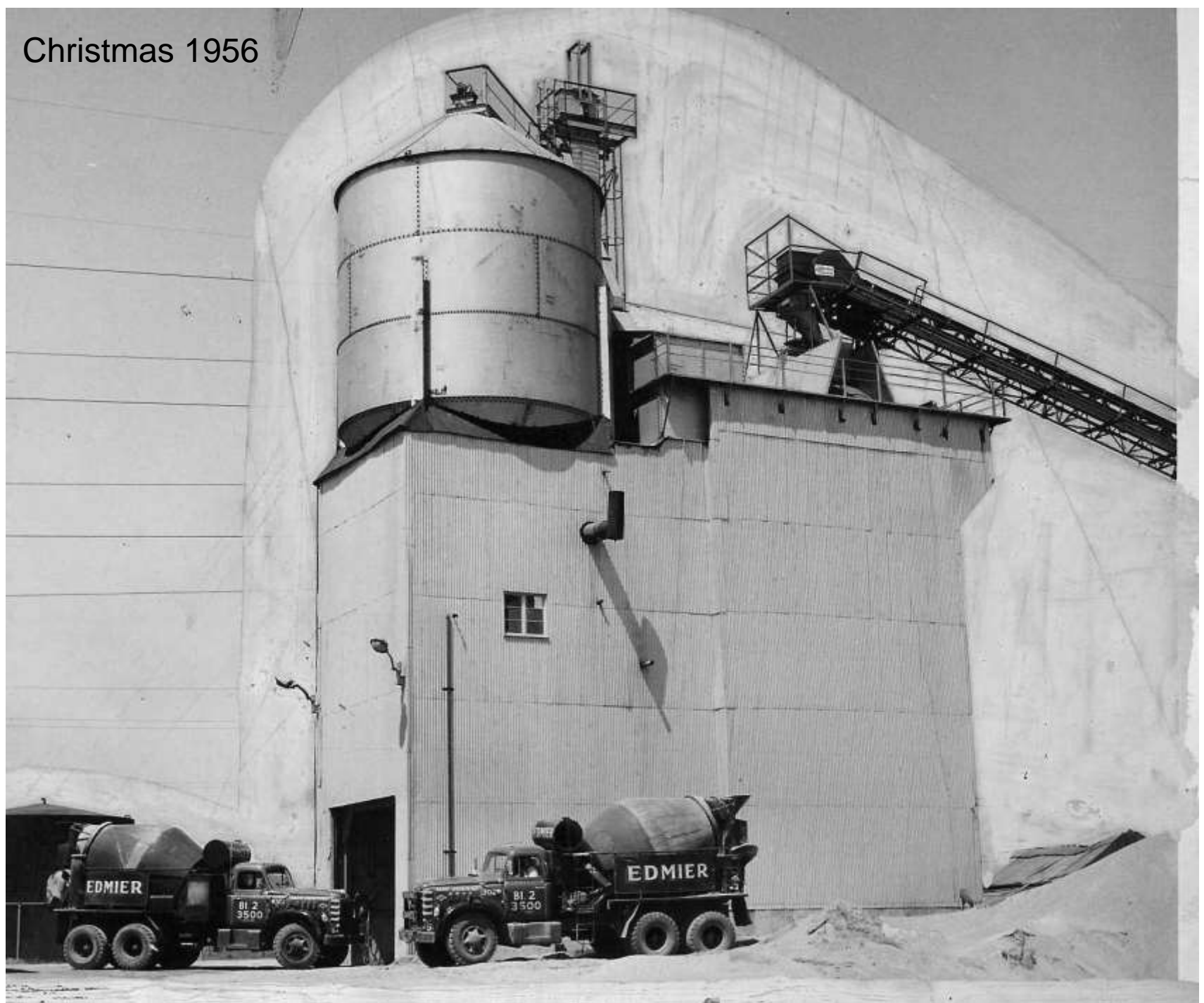
Tampa Sand & Material Co.  
1947



Courtesy, Tampa-Hillsborough County Public Library System



Christmas 1956





# Unloading of aggregate railcars

Gravity discharge into hopper

Take-away conveyor

# Unloading of aggregate railcars



Radial stack conveyor

# Aggregate Storage Piles



Aggregate Storage Pile

Radial stack conveyor,  
can go either to plant or  
to storage pile

Most aggregate arrives by truck and is either dumped in the fill hopper to fill the aggregate storage compartments or dumped at the storage piles

# Aggregate Fill Hopper(s) feeds the fill conveyor to feed the aggregate storage compartments

End dump and front end loader hoppers



Drive-over  
dump hopper

# Two ways of feed aggregate storage compartments



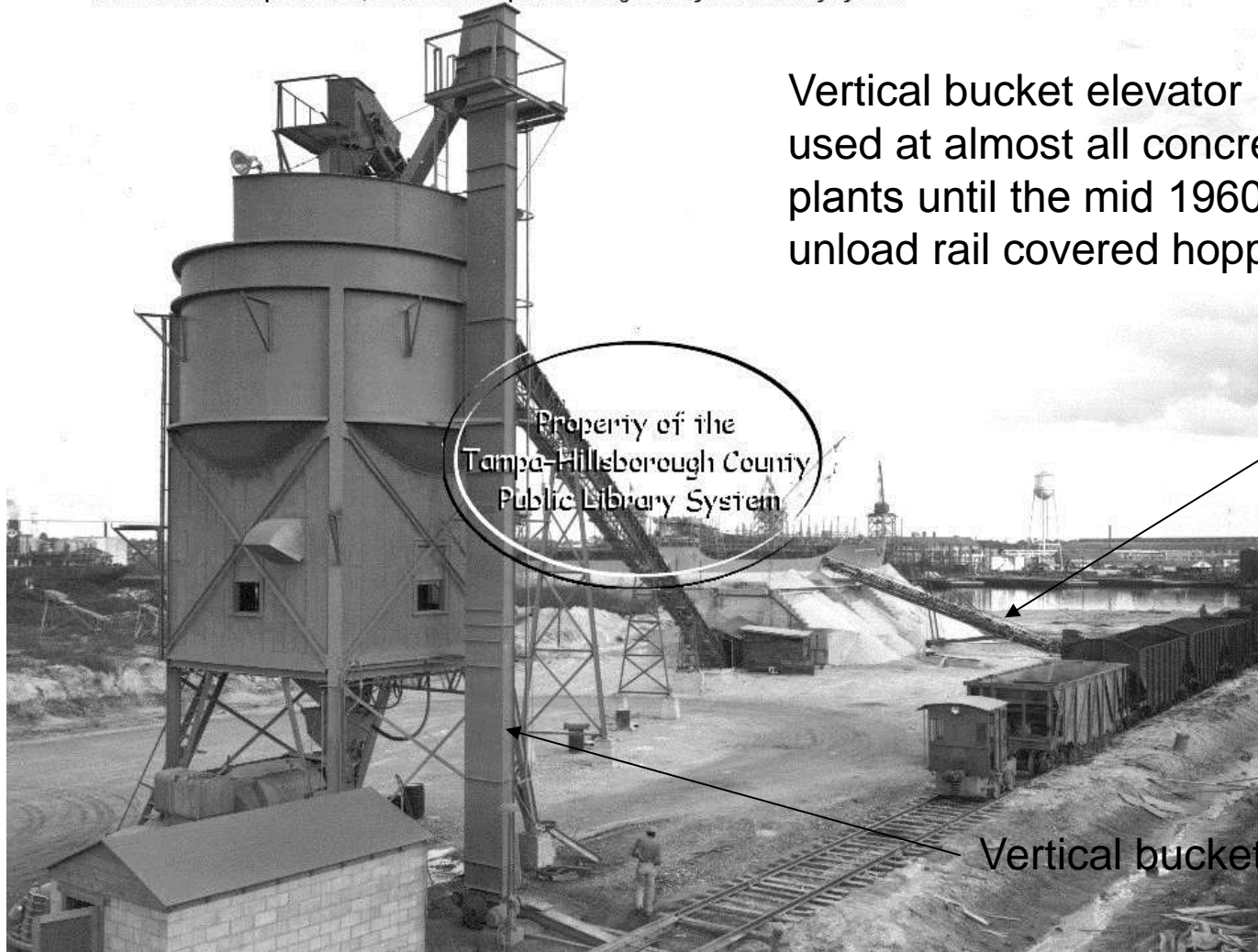
Aggregate fill conveyor used on 99.5% of all concrete plants built



Vertical Bucket Elevator (rarely used for aggregate)

# Two ways to feed cement to the cement storage silo or storage compartments

For information or reproductions, contact the Tampa-Hillsborough County Public Library System.



Vertical bucket elevator used at almost all concrete plants until the mid 1960's to unload rail covered hoppers

Property of the Tampa-Hillsborough County Public Library System

Rail aggregate unloading

Vertical bucket elevator for cement

Tampa Sand & Material Co. 1947

# Two ways feed cement to the cement storage silo or storage compartments



Almost all plants today use a pneumatic blower to “blow” the cement to the top of the silos or cement compartments





# Auxiliary Fly-Ash Silo

Cement silo



Fly-Ash silo



Cement compartments

# Available Models:

Aggregate compartments

Vertical elevator replaces fill conveyor

Walthers  
Cornerstone Series(R)  
Blue Star Ready Mix  
Concrete Batch P\_lant

# Other available models are of European Prototype Concrete Plants



Heljan Plastic A/S  
Cement Plant  
w/Material Storage  
Bins

# The Concrete is then delivered from the Concrete Plant by Concrete or Redi-Mix Trucks

Mack 1990's



Unloading the Concrete on the job site



1949 Ford

wles Collection



Late 1950's

1956 Diamond T





1958 FWD Mixer, picture taken around 1965/66



1966 Diamond Reo



1970 Kenworth



1984 Mack

# Available Concrete Truck Models:



Athearn B-model Mack Concrete Truck, introduced in 1953.

Athearn R-model Mack Concrete Truck, introduced in 1966.





# Available Concrete Truck Models:



Con-Cor Kenworth Concrete Truck, introduced late 1980's.

Con-Cor CH-model Mack Concrete Truck, introduced in 1994.



# Available Models:



Walthers Cornerstone ® Bulk Transfer Conveyor with pit and radial stacker

# Freight Cars used for hauling aggregate, typically open top Hoppers



40' Ortner 100 ton  
aggregate hopper,  
Models by Walthers,  
first built in 1970's.

Greenville 100 ton  
aggregate hopper,  
Models by Walthers,  
first built in 1970's.

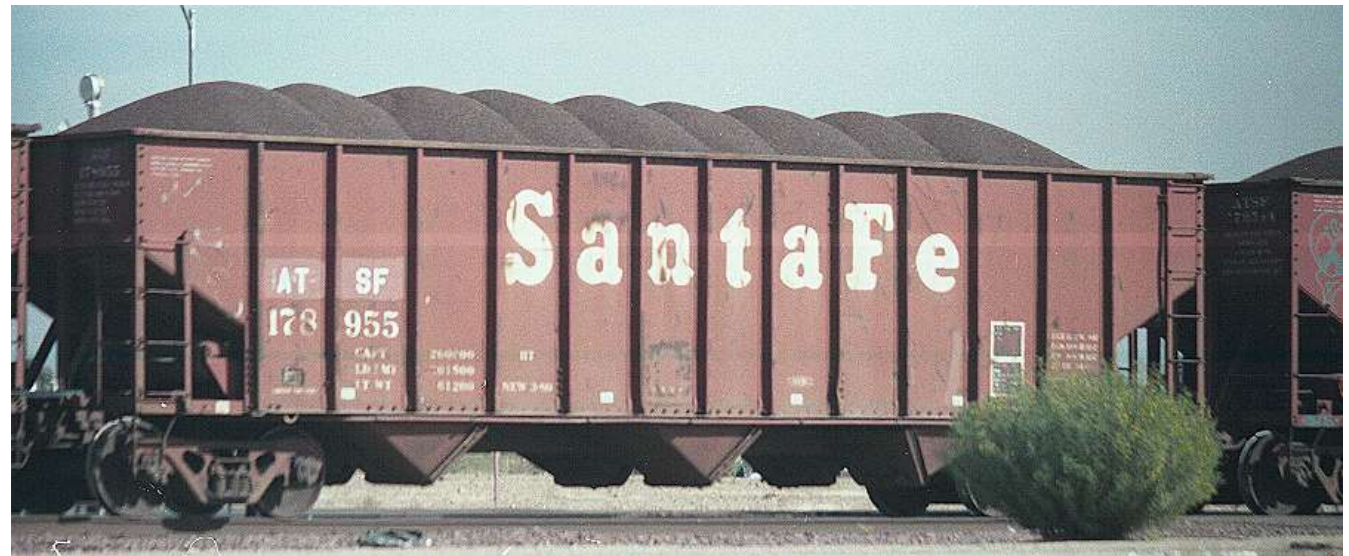


# Freight Cars used for hauling aggregate, typically open top Hoppers



Proto 2000, by  
Walthers, Steel-Side  
War Emergency 50 ton.

Assorted 100 ton  
3-bay hopper  
cars, use and  
type varied by  
railroad.



Most aggregate is delivered by truck from the local quarry, sand, or gravel pits directly to the Concrete Plant

B-model Mack Dump Truck,  
Straight Truck



1960 Mack



2006 Mack

Vision-model Mack  
Tractor with Dump  
Trailer



1970 Mack



1980 Mack



1975 White



1982  
Kenworth

# Available Dump Truck Models:



Athearn B-model Mack Dump Truck, introduced in 1953.

Athearn R-model Mack Dump Truck, introduced in 1966.



We need a good Dump Trailer model to go with those great Athearn Mack Tractors:



1973 R-model Mack Tractor with Axle Dump Trailer



Athearn R-model Mack Tractor, introduced in 1966.



Athearn B-model Mack Tractor, introduced in 1953.



## Resource for additional resources for 1900-1960

### **Shades of Gray, Sands of Time: Images of Concrete Construction in Days Past**

Item Code: CD061



**Description:** This collection of over 900 black and white photographs illustrates the building of our nation in the last century, the role of concrete in the process and provides glimpses of life in that era. These historical photographs illustrate concrete construction and equipment, including buildings and bridges, highways and streets, and other types of concrete structures under construction. Of special interest are several hundred images of machinery used in concrete construction: paving machines, earthmoving equipment, cranes, buckets, buggies and other "tools of the trade." Of these, there are 144 pictures showing vintage ready mix trucks, from the earliest models to those used in the fifties and sixties.

Price for the CD is \$35.00

<http://www.cement.org/bookstore/>

# Special thanks to:



The World's Leading Manufacturer of Concrete Products Equipment

Besser Company

Alpena, Michigan, USA

[www.besser.com](http://www.besser.com)

And to my dad,

**Jim Edmier**

for his expertise and in helping to identify the  
important dates and timelines for this clinic

**Thank you all for attending!**