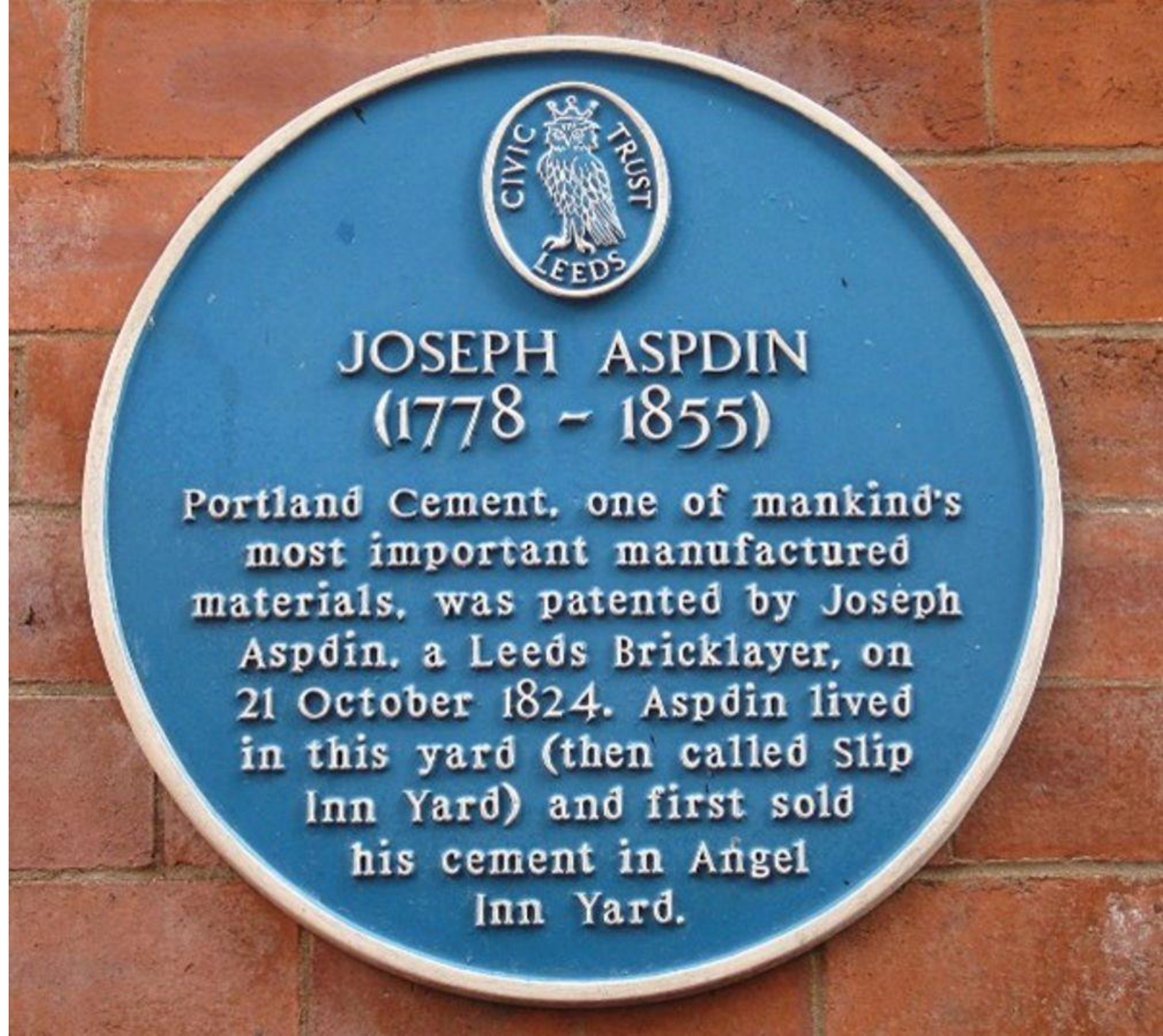


Todd Hanson

200th Anniversary of Portland Cement Patent

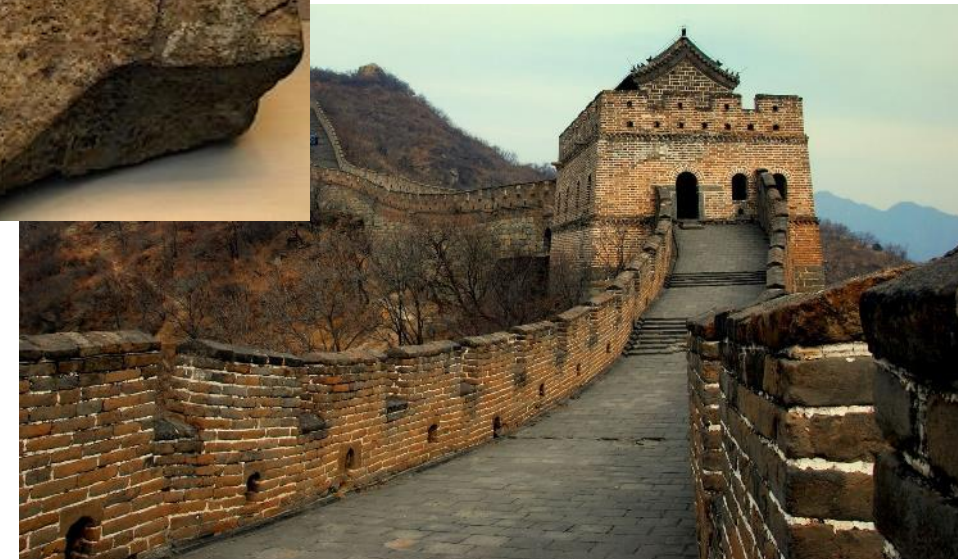
**60th Iowa Concrete Paving Conference
February 9, 2024**

Todd Hanson (IDOT) & Dave Suchorski (Ash Grove)



Ancient Concrete

- Nabatea (Jordan)
 - Lined cisterns with lime & sand
- Egyptians
 - Gypsum lime mortar
- China
 - sticky rice lime mortar
- Greeks
 - Pozzolan with lime



Ancient Concrete

- Roman Coliseum 80 AD
- 40 ft deep foundation used lime/pozzolana cement and heavy lava aggregate
- Lime/pozzolana mortar held bricks together
- Making cementing materials lost during Dark Ages



Natural vs. Portland Cement

Natural Cement



Typically, one source of rock (argillaceous (clayey) limestone). Burned at lower temperatures. Tan color

Portland Cement



Artificial blend of limestone, shale, clay, gypsum. Burned at higher temperatures. Gray color

Portland Cement

- Joseph Aspdin applied for patent in 1824
- Pulverized limestone and clay together, in a lime kiln and re-ground it.
- Balance of calcium, iron, silicon & aluminium produced predictable, high quality product
- First “artificial cement” to compete with “Roman Cement” (Natural)



Portland Cement

- Called it Portland cement because it resembled stone quarried on Isle of Portland



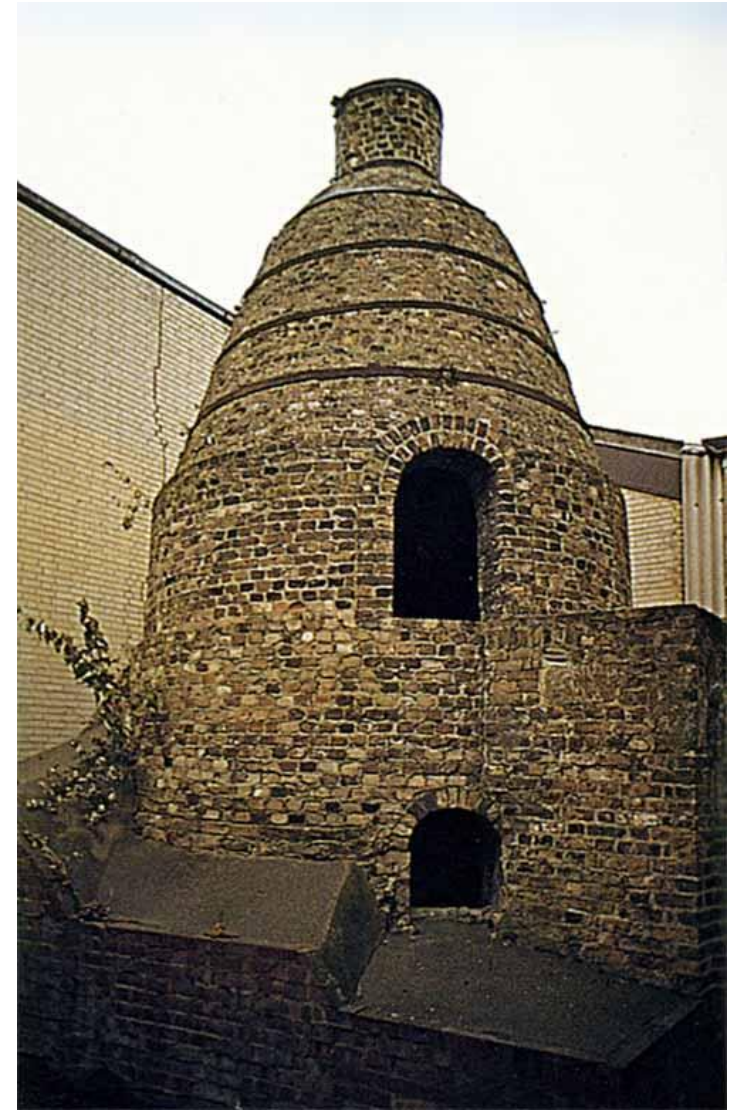
Portland Cement

- William Aspdin, Joseph's notorious son
- Booted from father's company
- Increased limestone content burned to higher temperature - hard burned clinker produced better cement
- Concrete beam load of >5 hundredweight – Fathers cement <3 hundredweight (112 lbs)
- “Patented Portland Cement” but did not get patent



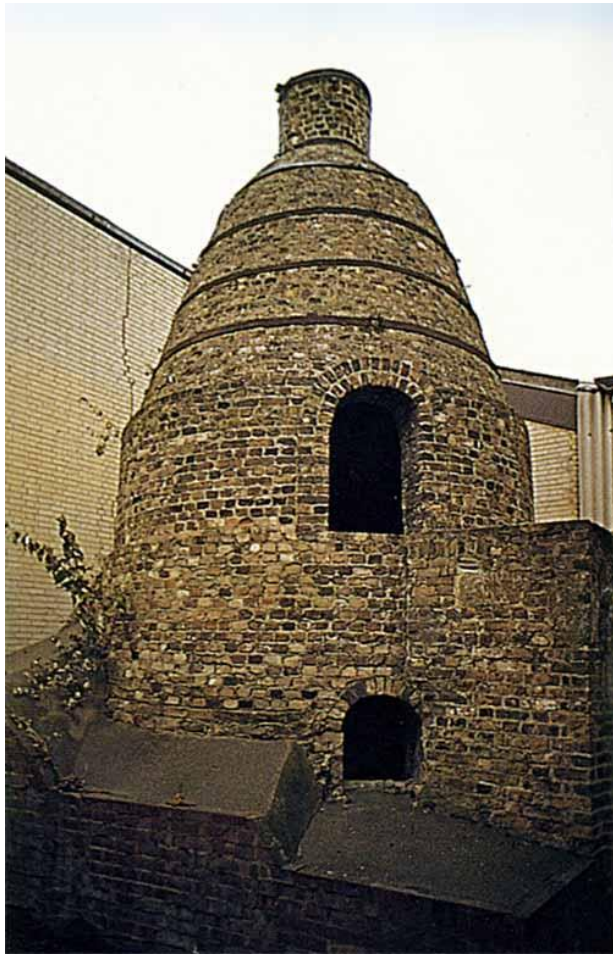
Portland Cement

- William Aspdin and William Robins partnership had 9 bottle kilns working
- Called Nine Bottle Cement
- Went bankrupt several times and ruined partnerships
- William sacrificed a unique triumph to his own greed, crookedness, & ineptitude
- Opened plants in Germany 1850s



William Aspdin's Bottle Kiln 12
Monument Northfleet, England

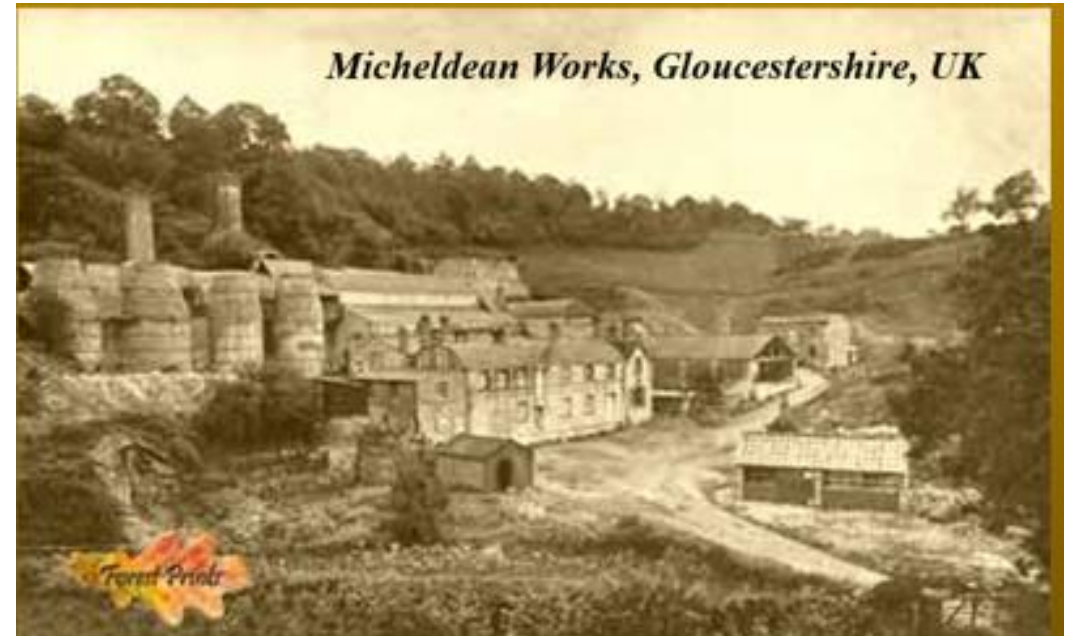
Cement Kilns



- Early cement production used bottle (or beehive) kilns
- Static – a ten foot kiln would produce about 10 tons of clinker per charge
- Loading and emptying took 12 hour shift
- Burning 2-4 days
- Cooling 1-2 days

Cement Kilns

- Thomas Crampton
 - 1st patent but never implemented
- Rotary kiln in 1885 by Frederick Ransome
- Not a commercial success
- Issues with low temps., fuel gas adding sulfur, blockages



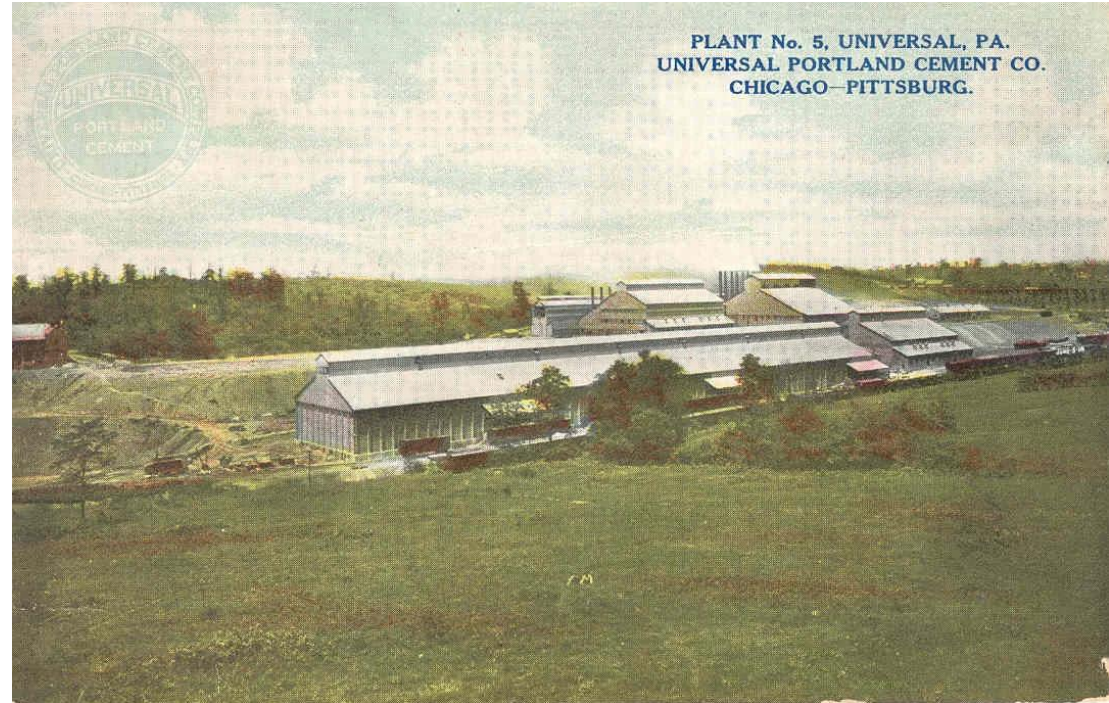
Portland Cement History - US

- David Saylor began cement production in the Lehigh Valley, PA
- Formed Coplay Cement Co. in 1866
- 1871 - Patent cement from natural rock similar to English Portland



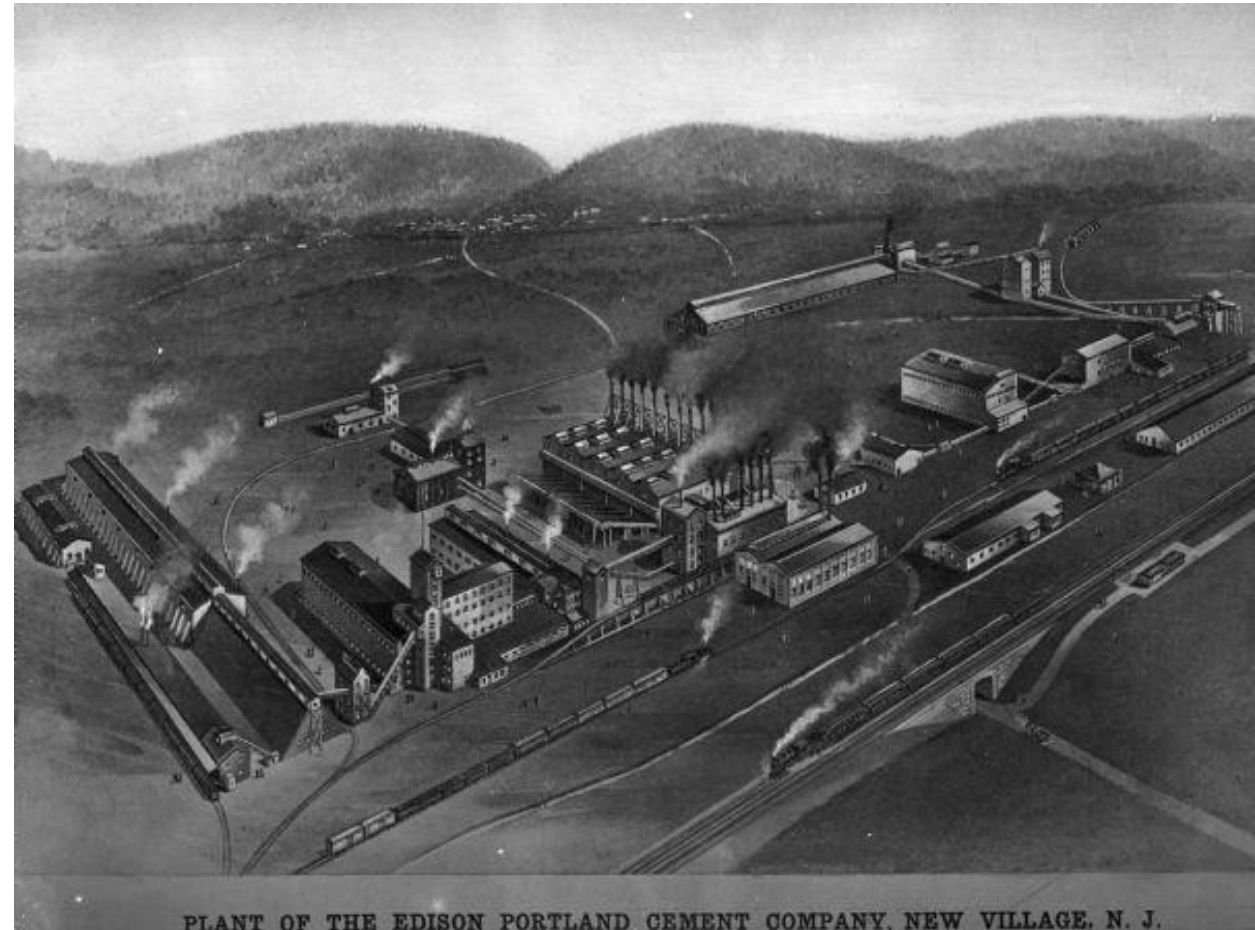
Portland Cement & Gypsum

- French expert P.I. Giron came to work at Atlas cement plant in US
- Discovered blending of plaster with Portland helped to regulate the set



Cement Kilns US

- In 1909, Thomas Edison patent for more efficient kilns up to 150 ft.
- Became the standard replacing 60-80 ft kilns
- First to use steam shovels for loading quarry rock
- Introduced well-drilling in quarries



PLANT OF THE EDISON PORTLAND CEMENT COMPANY, NEW VILLAGE, N. J.

Portland Cement US

- By 1895 , various American cement plants added the rotary kiln system
- Innovation so spectacular by 1907, the US cement industry was producing half the world production

PRODUCTION OF NATURAL AND PORTLAND CEMENTS IN THE UNITED STATES AND IMPORTATIONS OF PORTLAND CEMENT IN PERIODS OF FIVE YEARS FROM 1878 TO 1923 INCLUSIVE

Year	Natural Cement* (barrels)	Imported Portland** (barrels)	Domestic Portland (barrels)
1878	2,220,000 (Est.)	92,000	28,000
1883	4,100,000	456,418	90,000
1888	6,253,295	1,835,504	250,000
1893	7,411,815	2,674,149	590,652
1898	8,418,924	1,152,861	3,692,284
1903	7,030,271	2,251,969	22,342,973
1908	1,686,862	842,121	55,072,612
1913	744,658	85,470	92,097,131
1918	432,966	305	71,081,663
1923***		1,678,636	137,460,238

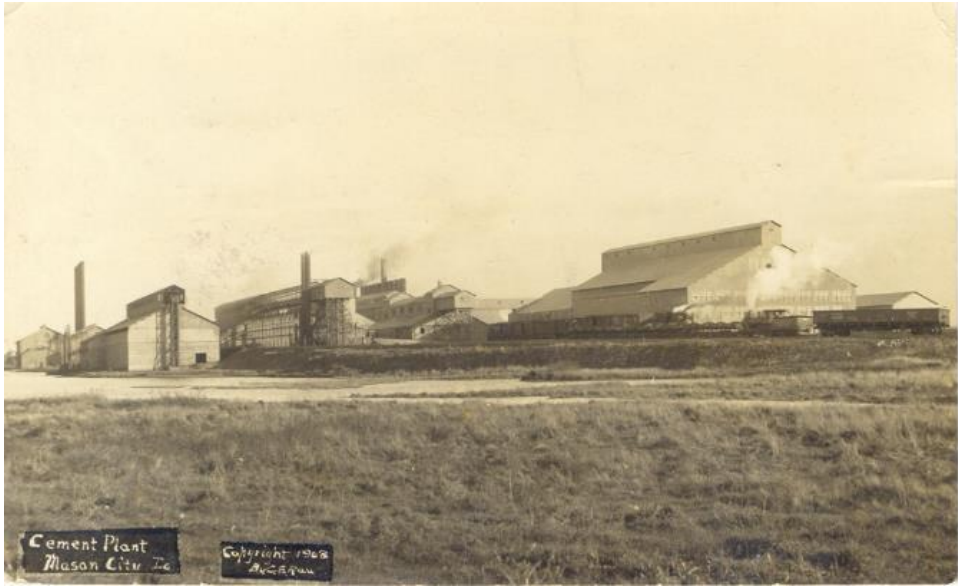
Portland Cement Quality Testing

- Standardized testing
- ASTM Committee C-1 1908
- 1922 First American Standard Specification common among all engineering societies



Tensile Test Equipment 1914

Portland Cement History – Iowa Sources



Northwestern States, Mason City -1908



Lehigh, Mason City -1910



Iowa Portland (Hawkeye), Des Moines -1909

Portland Cement History – Iowa Sources



Pyramid (Penn-Dixie), W.
Des Moines -1923



Dewey Portland, Davenport - 1927



Ash Grove, Louisville, NE -1929