AD-A149 916 DEPLOYMENT AREA SELECTION AND LAND WITHDRAWAL/ACQUISITION M-X/MPS (M-X/MU..(U) HENNINGSON DURHAM AND RICHARDSON SANTA BARBARA CA 02 OCT 81 1/1

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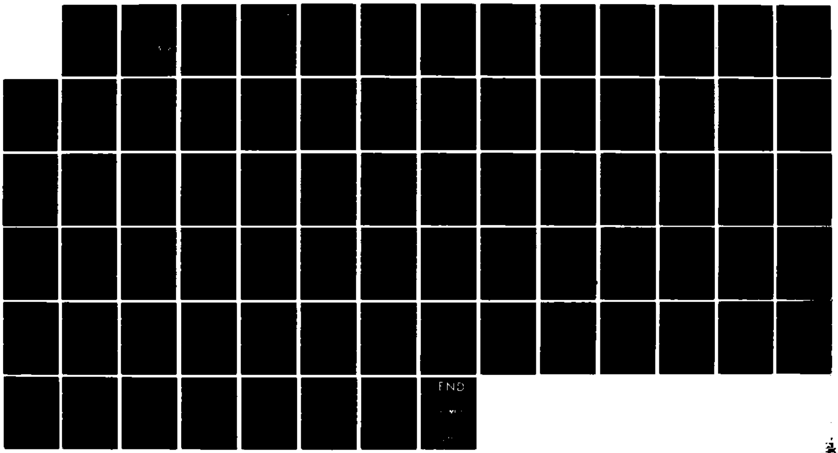

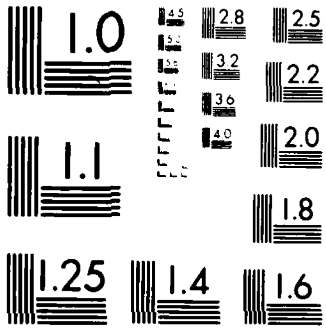

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(1)

M-X/MPS

ENVIRONMENTAL

TECHNICAL REPORT

PRELIMINARY FEIS

REVIEW COPY 2 OCTOBER 1981

ETR 25

CEMENT INDUSTRY

DEPLOYMENT AREA SELECTION
AND LAND WITHDRAWAL/
ACQUISITION

DEPARTMENT OF THE AIR FORCE

M-X ETR-25

ENVIRONMENTAL CHARACTERISTICS OF ALTERNATIVE DESIGNATED DEPLOYMENT AREAS: CEMENT INDUSTRY

Prepared for

United States Air Force
Ballistic Missile Office
Norton Air Force Base, California

By

Henningson, Durham & Richardson, Inc.
Santa Barbara, California

REVIEW COPY OF WORK IN PROGRESS

2 October 1981

DEPARTMENT OF THE AIR FORCE
WASHINGTON 20330

OFFICE OF THE ASSISTANT SECRETARY

Federal, State and Local Agencies

On October 2, 1981, the President announced his decision to complete production of the M-X missile, but cancelled the M-X Multiple Protective Shelter (MPS) basing system. The Air Force was, at the time of these decisions, working to prepare a Final Environmental Impact Statement (FEIS) for the MPS site selection process. These efforts have been terminated and the Air Force no longer intends to file a FEIS for the MPS system. However, the attached preliminary FEIS captures the environmental data and analysis in the document that was nearing completion when the President decided to deploy the system in a different manner.

The preliminary FEIS and associated technical reports represent an intensive effort at resource planning and development that may be of significant value to state and local agencies involved in future planning efforts in the study area. Therefore, in response to requests for environmental technical data from the Congress, federal agencies and the states involved, we have published limited copies of the document for their use. Other interested parties may obtain copies by contacting:

National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161
Telephone: (703) 487-4650

Sincerely,

JAMES F. BOATRIGHT
Deputy Assistant Secretary
of the Air Force (Installations)

1 Attachment
Preliminary FEIS

ACKNOWLEDGEMENT AND CAVEAT

This report was prepared from material developed by Frank K. Stuart & Associates, Salt Lake City, Utah, under contract to HDR Sciences, Santa Barbara, California. Its purpose is to provide baseline data and to develop a predictive model for price effects. The M-X project requirements incorporated into the report represent the best data available at the time the work was performed. The baseline data and the predictive model are approximate for use with any revised set of project requirements data.

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SUMMARY

Cement industry effects were frequently mentioned during scoping for the M-X Deployment Area Selections and Land Withdrawal/Acquisition EIS. M-X-related construction would require large quantities of cement for facilities such as protective shelters, operating bases, and runways, as well as for stimulated indirect development such as housing and commercial facilities. This study documents models to predict relative price effects with and without M-X construction in the regions.

1.0 CEMENT INDUSTRY BASELINE INFORMATION

This section of the study presents an overview of the cement industry in the United States, including historical patterns of demand, production, capacity, and prices. Specific descriptions of the industry in the market areas of Nevada/Utah and Texas/New Mexico are also presented.

1.1 THE CEMENT INDUSTRY IN THE UNITED STATES

The cement industry within the United States is very homogeneous. Most producers are single product manufacturers, and the dominant product in the industry is gray portland cement. (Council on Wage and Price Stability, 1977). ("Portland" is not a brand name but a generic term used to designate any hydraulic cement or cement product that hardens in the presence of water. For practical purposes, all hydraulic cement used in construction is portland cement.) Portland cement accounts for over 95 percent of all cement products used in the United States.

Other types of cement include (1) "white cements" such as stucco and terrazzo used for architecture; (2) "blended cements", a combination of portland cement and other cementitious materials; and (3) "masonry cement". These other types of cement generally account for less than 5 percent of the annual cement consumption within the United States (Portland Cement Association, 1978).

Table 1.1-1 presents historical data relating to the cement industry from 1960 through 1978. The production of cement increased from 62.8 million tons in 1960 to 85.5 million in 1978, an overall increase of 36.1 percent. From 1960 through 1973, cement production grew at an annual compounded growth rate of approximately 2.6 percent. This should not suggest that past growth be characterized as a smooth upward trend. Variation in production, especially during the 1966-1973 period, is not considered significant.

Cement production hit an all time high in 1973, reaching 87.6 million tons; however, the boom was short-lived. The cement industry was severely impacted by the recession which slowed production in the United States in 1974 and 1975. In 1974, production dropped to 82.9 million tons, approximately 4.7 million tons less than the 1973 level. The recession hit the nation's cement industry the hardest in 1975 when production dropped to approximately 69.7 million tons, 13 million tons less than 1974, and approximately 20 percent less than 1973.

With the recovery period that followed, cement production resumed its upward growth. Production reached 74.5 and 80.1 million tons in 1976 and 1977, respectively. In 1978, as noted above, production reached 85.5 million tons, the second highest production level in the 1960-1978 period.

Cement shipments show the same type of variation. However, the growth in shipments has been larger than the growth in production. In 1960, shipments totaled 62.5 million tons and rose to 90.7 million in 1973, representing an overall increase of 47.5 percent, compared to an increase of 36.1 percent increase in production over the same time period. On an annual compounded basis, the growth in shipments

Table 1.1-1. Characteristics of the cement industry, 1960-1978 (thousands of tons).

Year	Shipments[1,2]	Production[1]	Imports	Exports	Inventory[3]	Price[4] (Dollars Per Ton)
1960	61,492	62,817	772	35	6,704	17.95
1961	63,050	63,662	681	54	6,846	17.80
1962	65,258	66,163	1,059	71	7,332	17.61
1963	68,666	69,260	758	86	7,425	17.17
1964	72,054	72,453	683	134	7,475	17.12
1965	73,637	73,103	1,035	141	6,193	16.90
1966	74,722	75,533	1,328	201	7,651	16.74
1967	73,371	72,539	1,112	184	7,807	16.87
1968	77,980	77,507	1,370	177	7,892	16.95
1969	80,319	78,375	1,921	111	7,129	17.20
1970	76,385	76,116	2,597	159	6,574	17.88
1971	82,297	80,317	3,088	125	6,425	19.01
1972	85,282	84,556	4,911	101	7,035	20.59
1973	90,727	87,573	6,686	325	5,557	22.23
1974	82,914	82,888	5,732	290	7,510	26.79
1975	70,684	69,721	3,702	494	6,923	31.41
1976	75,226	74,495	3,107	466	7,185	34.25
1977	81,614	80,060	4,038	239	6,074	36.76
1978	87,999	85,481	6,577	55	5,351	41.17

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[1]Data cover portland and masonry cement for the 50 states and Puerto Rico, and include cement produced from imported clinker.

[2]Includes imported cement shipped by domestic producers.

[3]From 1973 to 1978 annual data also covers Puerto Rico.

[4]Annual data are average f.o.b. plant and are from the Bureau of Mines annual canvass.

Source: Bureau of Mines, Minerals and Materials, A Monthly Survey, January 1980.

from 1960 through 1973 averaged approximately 3.0 percent compared to 2.6 percent for production (see Figure 1.1-1).

Shipments of cement in the United States, like cement production, declined in 1974 and 1975 due to the recession. Cement shipments dropped from the previous high of 90.7 million tons in 1973 to 82.9 million tons in 1974. Shipments continued their downward trend in 1975, declining to 70.7 million tons. Only in the period preceding 1965 had shipments of cement reached as low a point as they did in 1975.

With the recovery that followed the 1974-1975 recession, cement shipments resumed an upward growth. Shipments totaled 75.2 million tons in 1976 and increased to 81.6 million tons in 1977. Shipments continued to increase, reaching 88.0 million tons in 1978, approximately 26 percent over the recessionary demand of 1975.

Almost all portland cement shipments are in bulk, with the basic unit of measure the 2,000-pound ton. Bulk shipments account for 92 percent of cement sales, with 94-pound bags comprising the remaining 8 percent (Portland Cement Association, 1978).

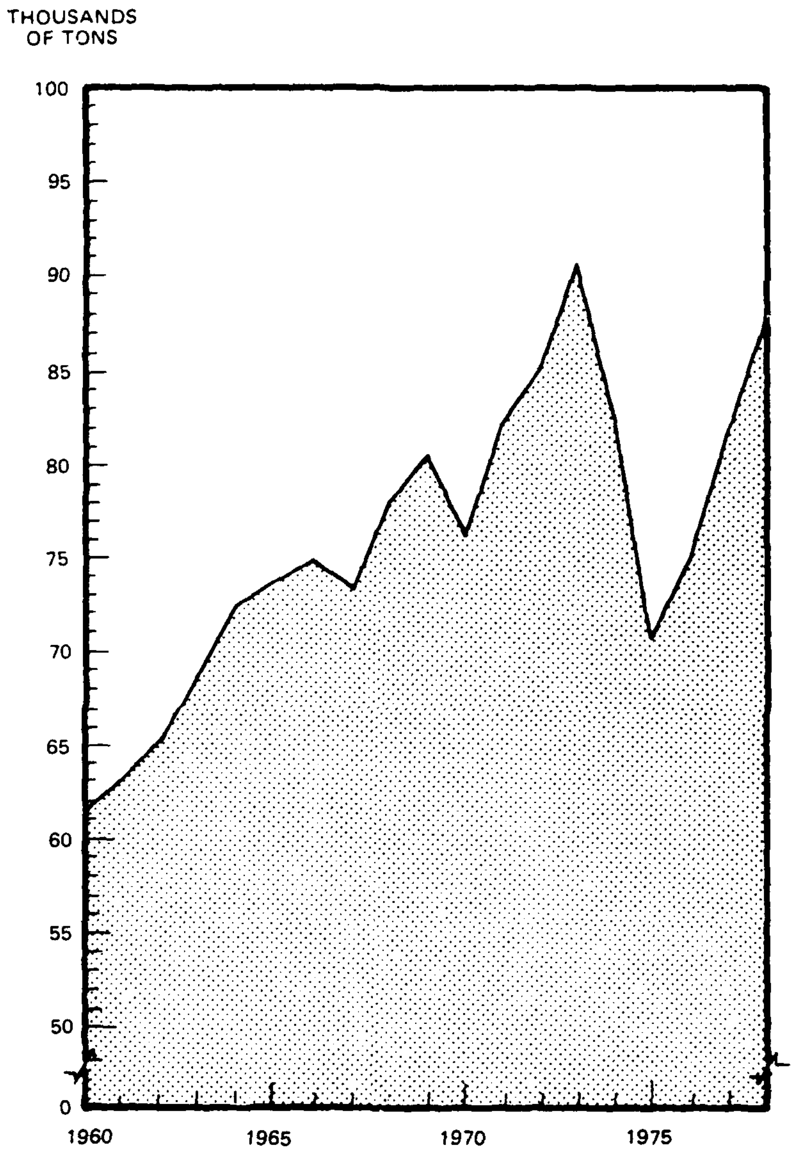
Cement use by customer category is illustrated in Figure 1.1-2. Ready-mixed concrete producers constitute almost two-thirds of all cement users in the United States. Other large consumers are concrete products manufacturers, highway contractors, and building material dealers.

The consumption of cement is usually directly related to the volume of construction (see Figure 1.1-3). Although some variation exists, it is usually due to changes in the construction mix from cement intensive construction projects, such as highway paving, to less intensive projects, like grading and drainage (Portland Cement Association, 1978). No single construction category, however, can be considered a key indicator of cement use. Many analysts believe that cement use in the short run is sensitive to changes in residential construction, which accounts for 25 to 30 percent of total cement use (Portland Cement Association, 1978).

The relationship between cement use and several construction categories is depicted graphically in Figures 1.1-4 through 1.1-7. These figures indicate the difficulty in forecasting cement use on the basis of expected growth in any single category.

Imports of cement into the United States have shown a rapid increase. In 1960, imported cement totaled 772,000 tons and comprised only 1.3 percent of the industry's total shipments. In 1978, imports totaled 6,577,000 tons and accounted for approximately 7.5 percent of total cement shipments. The increasing use of imported cement has partially resulted from the growth in shipments exceeding the growth in production.

Figure 1.1-8 illustrates change in cement prices from 1960 through 1978 in current dollars. In 1960, the per ton price of cement was $17.95. The price in current dollars declined gradually from 1960 through 1967, finally reaching a low in 1967 of $16.87 per ton. Cement prices began moving upward in 1968 when the per ton price increased to $16.95. The price of cement continued its upward movement but increases were dampened somewhat by the wage and price controls that were in



SOURCE: BUREAU OF MINES, MINERALS AND MATERIALS, A MONTHLY SURVEY, JAN. 1980.

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Figure 1.1-1. Cement shipments, 1960-1978.

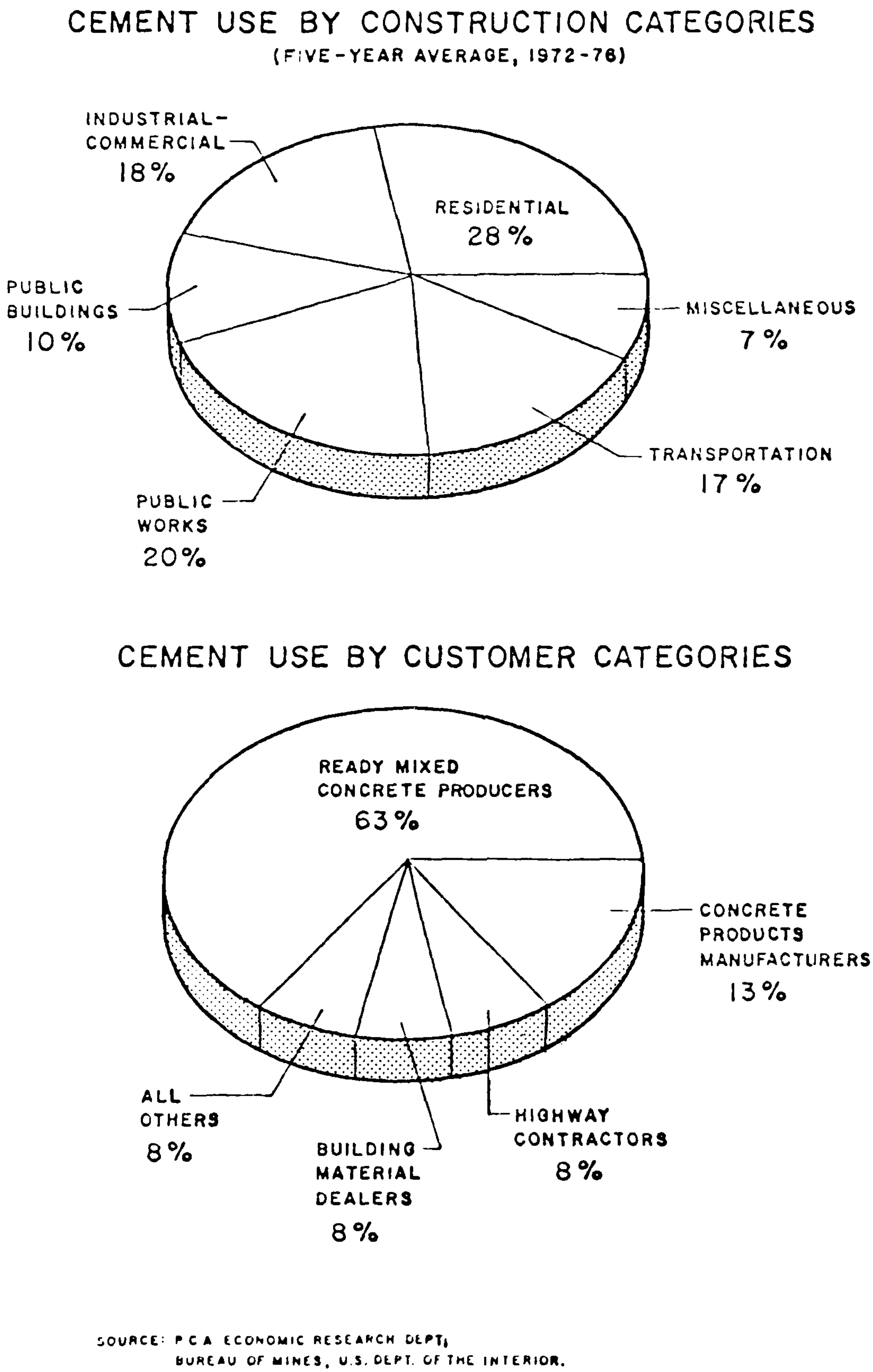

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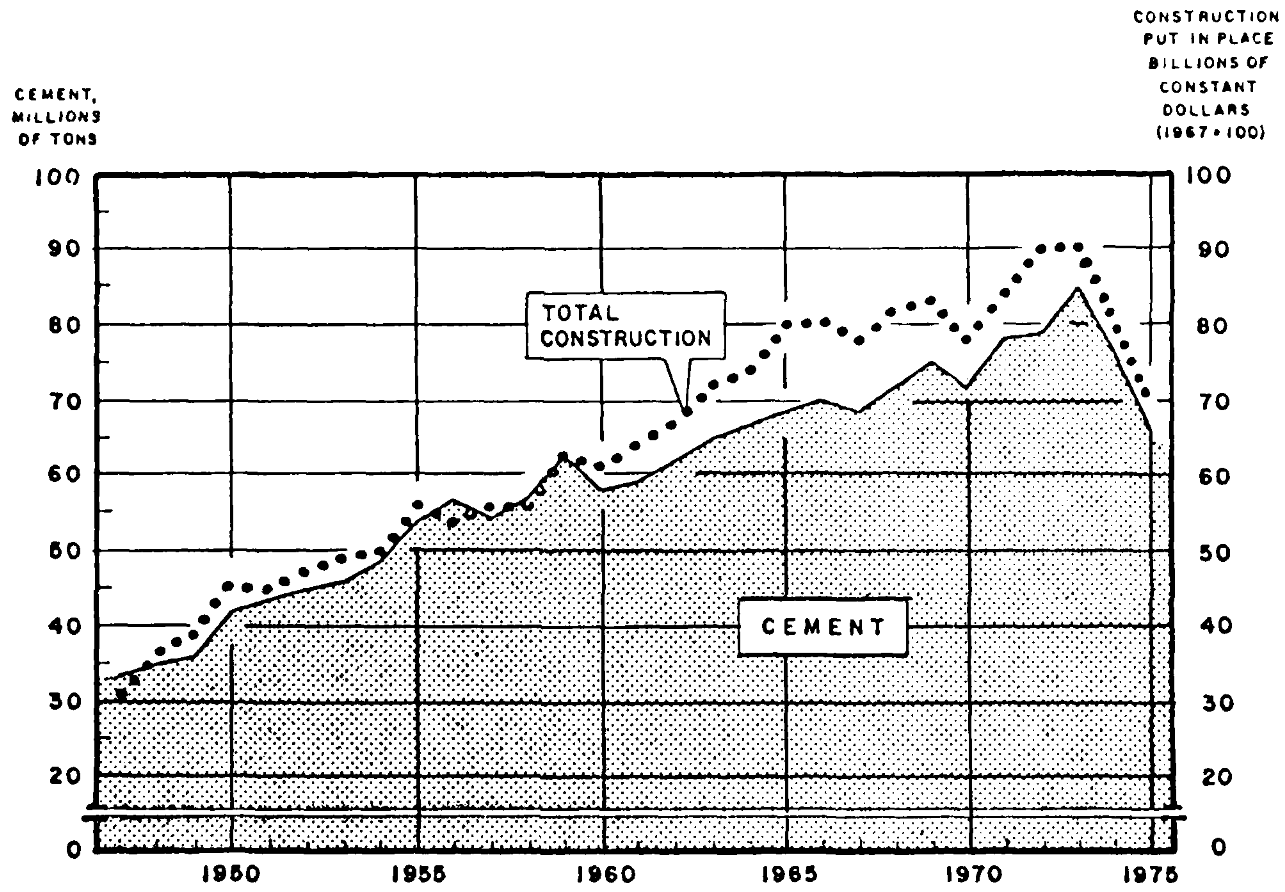
Figure 1.1-2. Cement use by construction and customer categories.



SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR, P C A ECONOMIC RESEARCH DEPT.

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Figure 1.1-3. Comparison of total construction put in place with cement consumption.

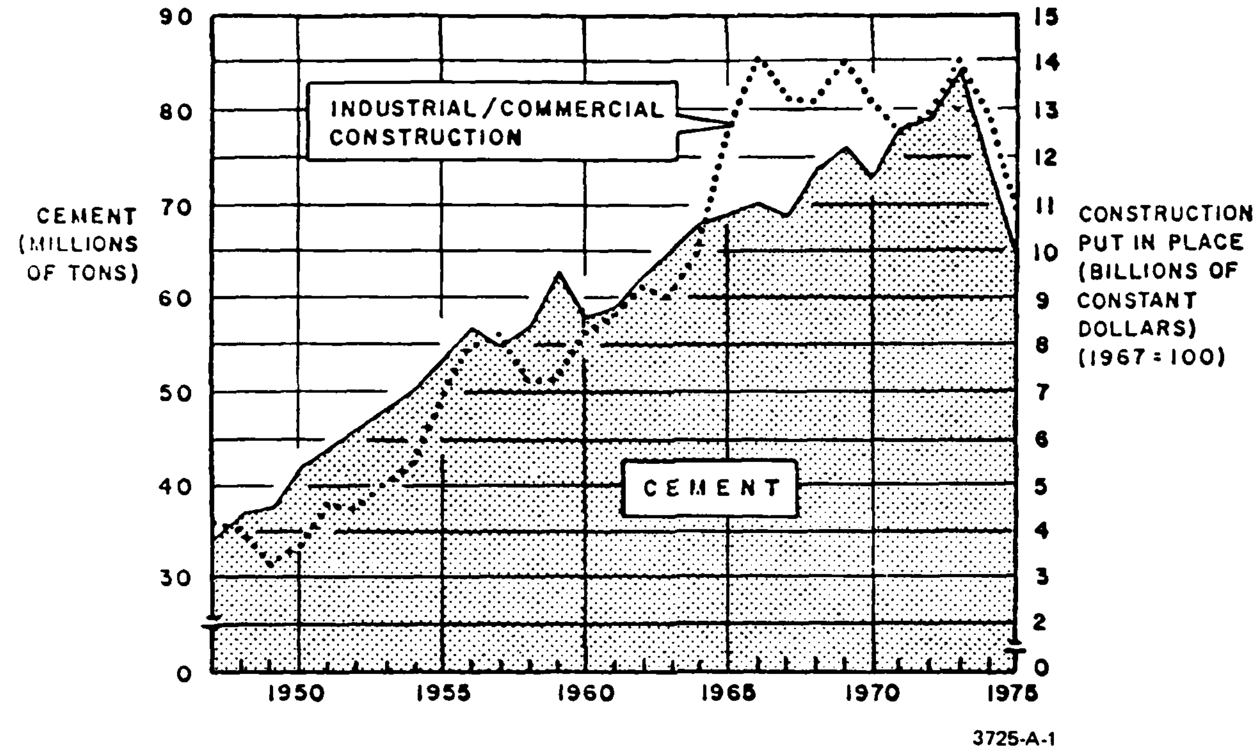
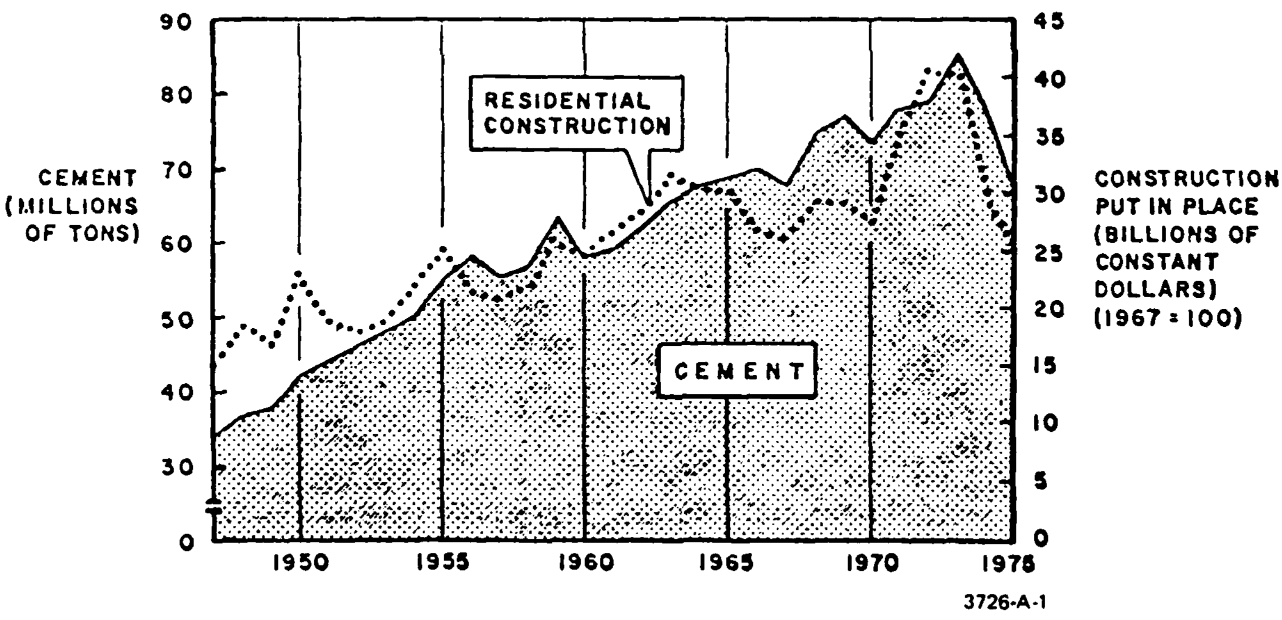


Figure 1.1-4. Comparison of industrial-commercial construction with cement consumption.



SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR, P C A ECONOMIC RESEARCH DEPT.

Figure 1.1-5. Comparison of residential construction with cement consumption.

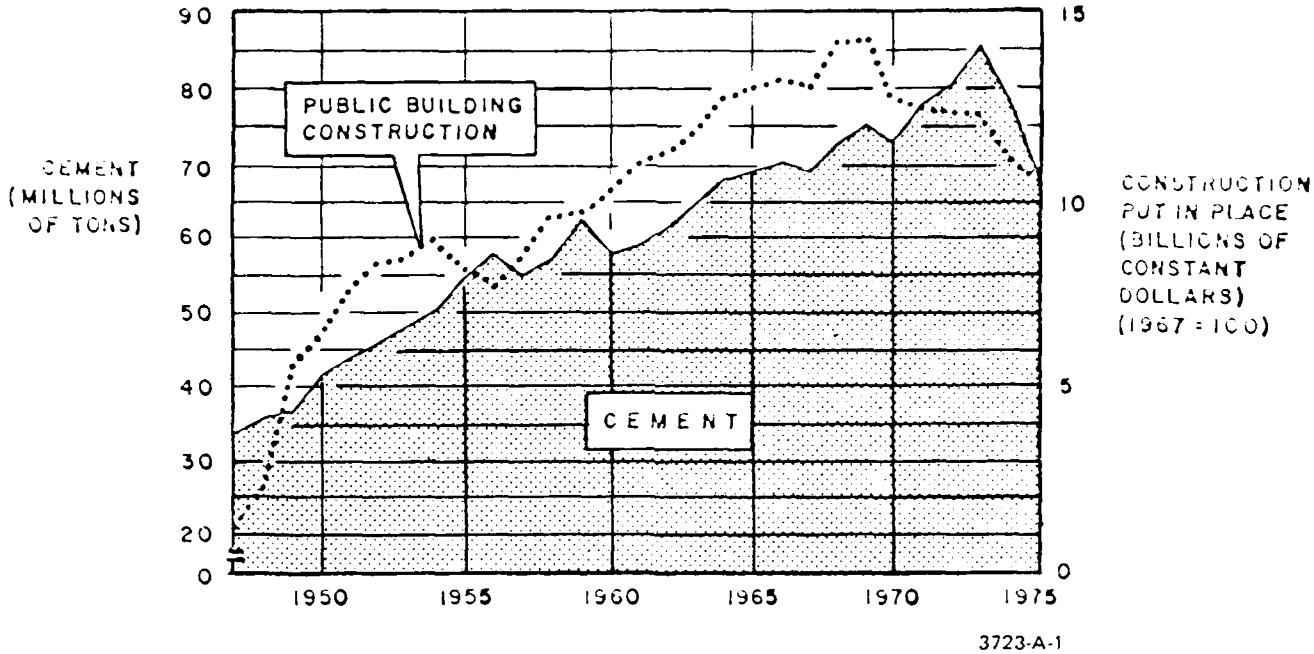
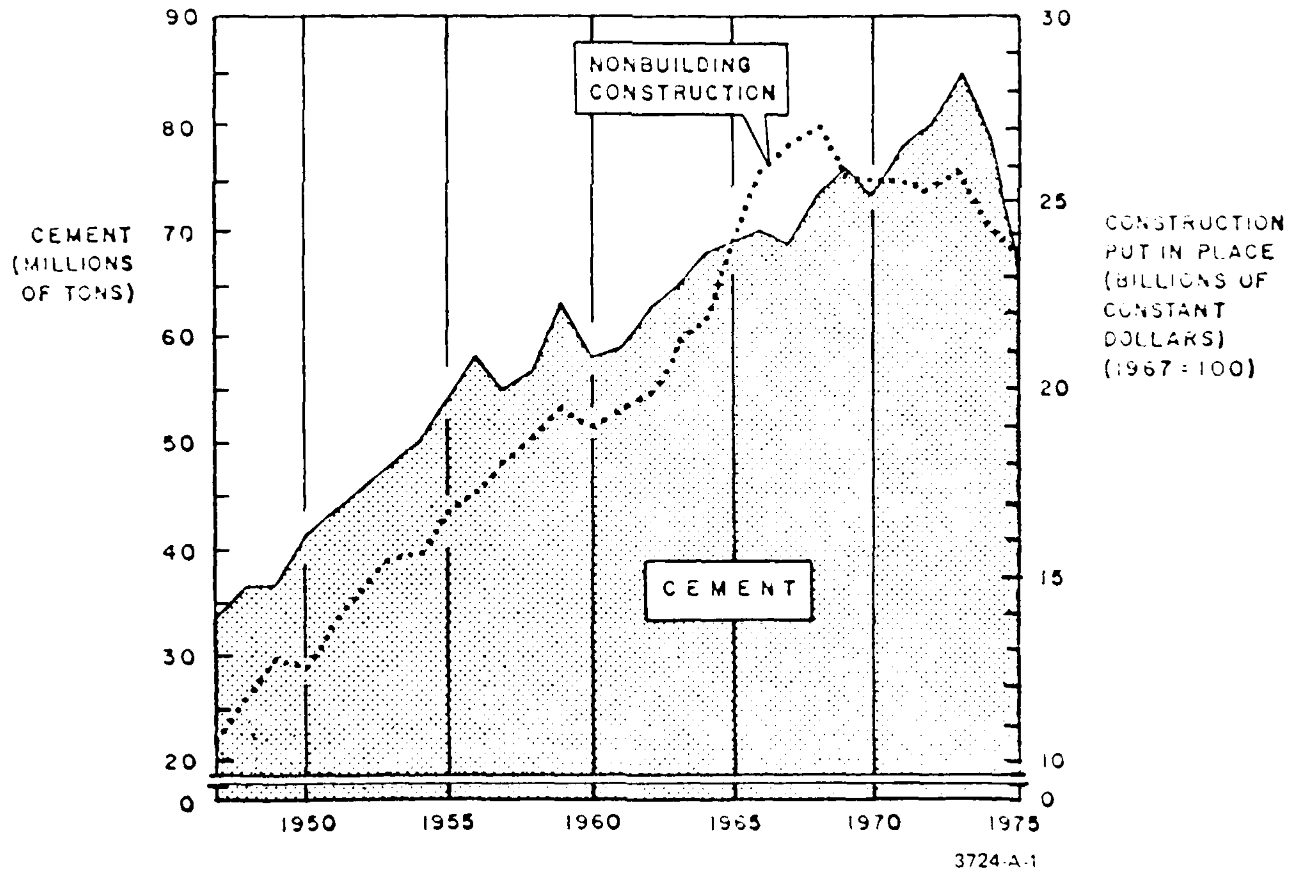
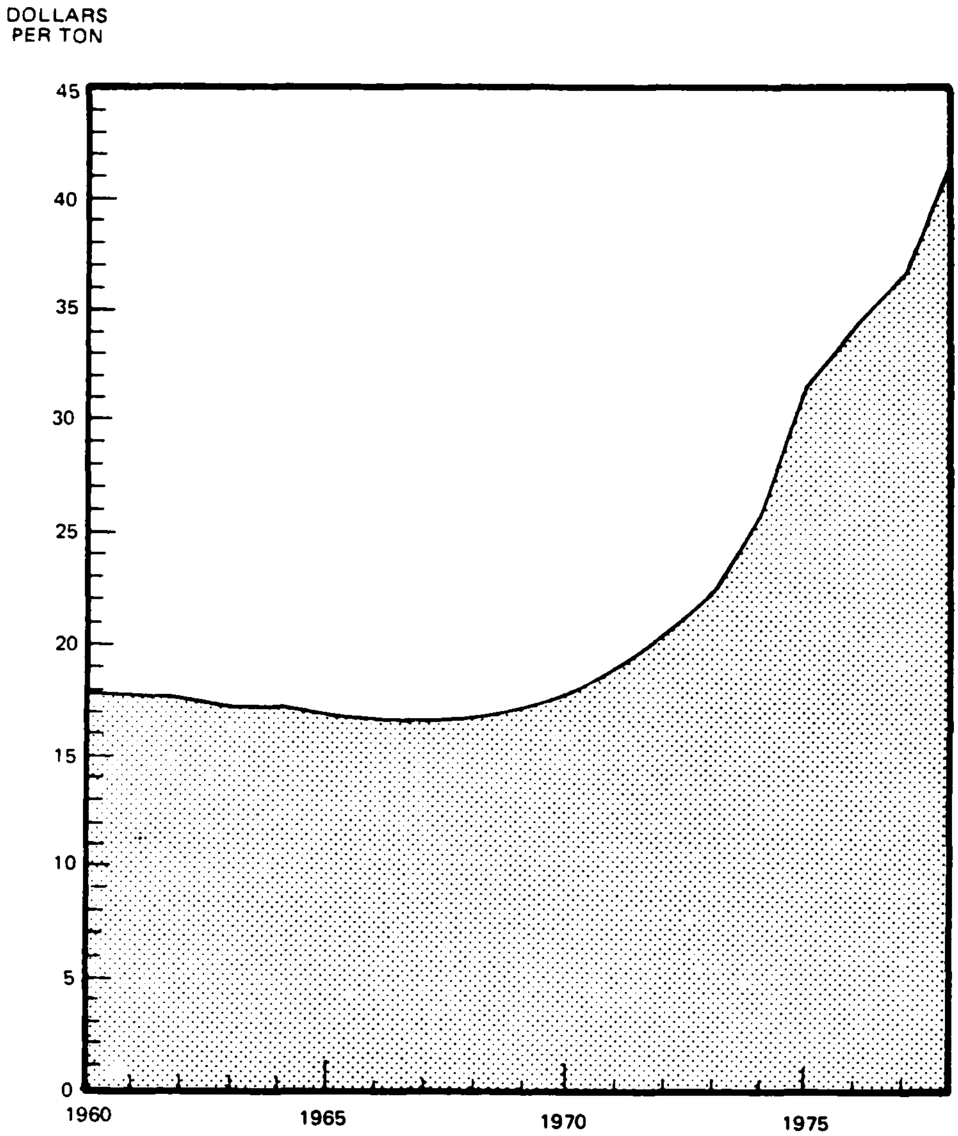


Figure 1.1-6. Comparison of public building construction with cement consumption.



SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR, P.C.A. ECONOMIC RESEARCH DEPT.

Figure 1.1-7. Comparison on nonbuilding construction with cement consumption.



SOURCE: BUREAU OF MINES, MINERALS & MATERIALS, A MONTHLY SURVEY, JAN 1980.

3730-A-1

Figure 1.1-8. Cement prices in the United States, 1960-1978.

effect in 1971 and 1972. Price controls were removed in the cement industry in November of 1973. Since 1973 the price of cement has shown a rapid increase, rising from $22.23 per ton in 1973 to $41.17 in 1978, indicating an average compounded growth rate of 13.1 percent per year. Since 1960 the price of cement has increased at an average annual compounded rate of 4.7 percent.

A major cause of the rapid price increases experienced since 1973 has been the cost of energy. The production of cement has been identified by the Department of Commerce as one of the six most energy-intensive industries. Energy represents approximately one-third of the manufacturing cost of cement. Through a conscientious effort to conserve energy and reduce costs, the energy required to produce one ton of cement has declined from 7.75 million BTUs in 1950 to 6.31 million in 1976 (Portland Cement Association 1978).

In addition, a greater reliance on coal is taking place. Where feasible, plants relying on oil and gas as their primary fuel are converting to coal. In 1972 only 39 percent of cement production was manufactured with coal or coke compared to 55 percent in 1976. It is estimated that by 1980 almost 90 percent of cement production will be fueled by coal (Portland Cement Association, 1978).

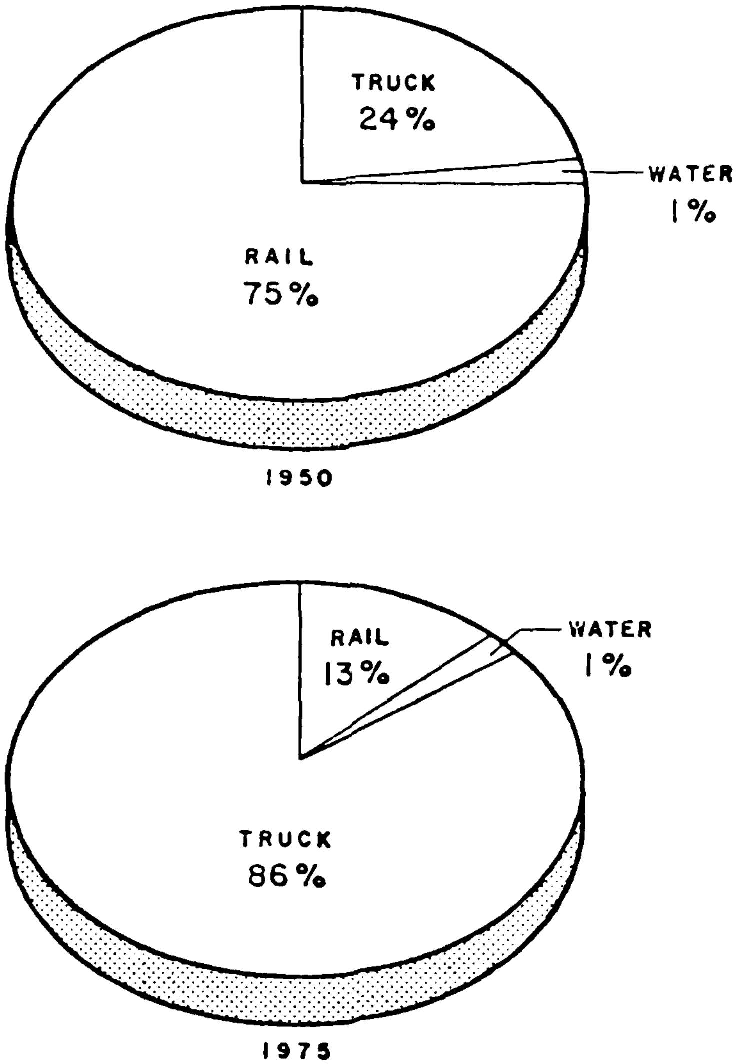
Prices in the future will largely be influenced by energy and transportation costs, levels of demand, production capacity, imports, and the structure of the cement industry.

Because of the low value-to-weight ratio, cement tends to be a regional industry with principal markets tending to range within a 200 mi radius of the plant. Beyond 200 mi, overland transportation costs become excessive. Plants with access to navigable waters can significantly expand their markets up to possibly 1,000 mi from the point of production. Generally, about 57.5 percent of all cement shipments occur within 99 mi of the producing plant. Over 95 percent of all shipments are within 300 mi of the producing plant.

Figure 1.1-9 illustrates the trend in the mode of transportation of cement. In 1975, trucks hauled the vast majority of cement, 86 percent. Although railroads transported 75 percent of all shipments in 1950, they transported only 13 percent in 1975. Water transportation has remained constant at one percent of cement shipments.

Because of the regional nature of the cement industry, prices can vary substantially between regions. Regional shortages frequently develop and transportation costs make the solution to the problem expensive. For example, in the spring of 1978, 80,000 tons of cement were needed to complete a runway at Stapleton International Airport in Denver. Because local cement production was commited to extensive residential and building activity, it was necessary to ship cement by rail from as far away as Missouri. These freight costs increased the delivered cost of cement by more than $10 per ton or about 47 cents per 94 pound bag over the price of local cement (U.S. Department of the Interior, Bureau of Mines, 1978).

Capacity utilization rates for plants producing portland cement are set forth in Table 1.1-2. Capacity utilization rates have varied since 1970 from a high of 90.6 percent in 1972 to a low of 62.9 percent in 1975. These rates appear to be



SOURCE: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR, P C A ECONOMIC RESEARCH DEPT.

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Figure 1.1-9. Trend in mode of transportation for cement shipmerts.

Table 1.1-2. United States cement industry capacity utilization rates, 1970-1978.

Year	Capacity Utilized (Percent)
1970	88.4
1971	87.8
1972	90.6
1973	83.2
1974	74.8
1975	62.9
1976	68.4
1977	73.5
1978	77.8

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Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

influenced by the general economy and the demand; for instance, the low utilization rates in 1974 and 1975 coincide with the recession experienced in the United States during that time period and the resulting low demand for cement.

As of December 31, 1979, there were 49 cement companies operating 149 clinker-producing plants and 8 grinding-only plants in 40 states. A list of cement companies and their respective capacities are set forth in Table 1.1-3. Current capacity for the United States portland cement industry totals 100,718,000 tons annually.

Cement company sizes range from firms with only one small plant to companies with as many as 13 plants. Even the largest cement producers are relatively small when compared to other firms in the steel, forest products, aluminum, and other construction materials industries. The largest United States cement company, Lone Star Industries, Inc., accounted for 7.3 percent of the industry's total capacity in 1979. The top four companies had 24.7 percent of the total capacity, the top five 29.4 percent, and the top 10 less than 50 percent.

Table 1.1-4 sets forth the production capacity of cement plants by state. Texas has the largest annual production capacity, 10,318,000 tons. This represents about 10 percent of the industry's total capacity. California's capacity of 10,313,000 tons ranks second in the nation. Overall, five states -- Texas, California, Pennsylvania, Michigan, and New York --accounted for approximately 43 percent of total capacity in 1979 (Portland Cement Association, 1979).

Announced increased capacity changes for the cement industry in the United States are as follows:

1980	3,503,000 tons
1981	3,410,000 tons
1982	2,688,000 tons
1983	315,000 tons
Total	9,916,000 tons

Source: Portland Cement Association, 1979.

Also, approximately 1,640,000 tons of additional annual capacity is planned, although there is no indication of the operational date of the capacity changes.

A substantial proportion of the planned capacity changes through 1983 will occur in three states -- Texas, California, and Utah. By 1983, plans call for Texas to have an additional capacity of approximately 3,000,000 tons per year. Planned capacity additions for California total 2,692,000 tons and for Utah 1,150,000 tons. In addition, 580,000 tons of annual capacity are planned for Utah, although there has been no indication of the operational date.

Table 1.1-3. United States cement company capacities.[1]

Rank	Cement (1,000 tons)	Percent of Industry	Name
1	7,313	7.3	Lone Star Industries, Inc.
2	6,460	6.4	Ideal Basic Industries
3	6,112	6.1	Gifford-Hill Co.
4	4,892	4.9	General Portland, Inc.
5	4,736	4.7	Martin Marietta Corp.
6	4,124	4.1	Medusa Corp.
7	4,117	4.1	Marquette
8	3,806	3.8	Universal Atlas Cement
9	3,743	3.7	Kaiser Cement and Gypsum Corp.
10	3,520	3.5	National Gypsum Company
11	3,480	3.5	Dundee Cement Co.
12	3,200	3.2	Lehigh Portland Cement Co.
13	3,030	3.0	California Portland Cement Co.
14	2,960	2.9	Southwestern Cement
15	2,630	2.6	Missouri Portland
16	2,470	2.5	Louisville Cement Co.
17	2,417	2.4	Penn-Dixie Industries, Inc.
18	2,215	2.2	The Flintkote Co.
19	2,050	2.0	Alpha Portland Industries
20	2,025	2.0	Texas Industries, Inc.
21	1,768	1.8	Centrex Corporation
22	1,550	1.5	Atlantic Cement
23	1,460	1.4	OKC Corporation
24	1,420	1.4	Independent Cement Corporation
25	1,306	1.3	Ash Grove Cement Co.
26	1,200	1.2	Oregon Portland Cement Co.
27	1,150	1.1	River Cement Company
28	1,140	1.1	South Dakota Cement Plant
29	1,100	1.1	Coplay Cement
30	1,040	1.0	Citadel Cement
31	1,000	1.0	Northwestern States Portland Cement Co.
32	950	0.9	Columbia Cement
33	900	0.9	Gulf Coast Cement
34	900	0.9	The Monarch Cement Co.
35	855	0.8	Giant Portland and Masonry Cement Co.
36	850	0.8	Arkansas Cement
37	800	0.8	National Cement
38	790	0.8	The Whitehall Cement Manufacturing Co.
39	700	0.7	Monolith Portland Cement Co.
40	660	0.7	Florida Mining and Material Corp.
41	625	0.6	Keystone Portland Cement Co.
42	550	0.5	Aetna Cement
43	520	0.5	Rinker Cement
44	434	0.4	Alamo Cement Co.
45	400	0.4	Wyandotte Cement
46	375	0.4	SME Cement, Inc.
47	355	0.4	Capitol Aggregates Cement
48	350	0.3	National Portland of Florida
49	270	0.3	Cyprus Hawaiian Cement
Total	100,718		

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[1]Includes gray, white, and grinding-only facilities.

Source: Market and Economic Research, Portland Cement Association, Old Orchard Road, Skokie, Illinois.

Table 1.1-4. United States cement plant capacities by state.

Rank	Cement (1,000 tons)	State	Rank	Cement (1,000 tons)	State
1	10,318	Texas	21	1,641	Colorado
2	10,313	California	22	1,245	Arkansas
3	9,590	Pennsylvania	23	1,200	Virginia
4	7,576	Michigan	24	1,164	Louisiana
5	5,609	New York	25	1,140	South Dakota
6	4,981	Missouri	26	1,025	Nebraska
7	4,368	Florida	27	990	Oregon
8	3,975	Alabama	28	935	West Virginia
9	3,791	Indiana	29	780	Utah
10	3,086	Iowa	30	740	Mississippi
11	2,923	Illinois	31	660	Kentucky
12	2,639	South Carolina	32	650	Montana
13	2,541	Ohio	33	610	North Carolina
14	2,386	Kansas	34	590	Hawaii
15	2,034	Tennessee	35	505	New Mexico
16	1,960	Oklahoma	36	480	Maine
17	1,950	Maryland	37	430	Nevada
18	1,807	Washington	38	310	Wisconsin
19	1,720	Arizona	39	210	Idaho
20	1,646	Georgia	40	200	Wyoming
			Total	100,718	

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Note: There are no cement plants in the following states: Alaska, Connecticut, Delaware, District of Columbia, Massachusetts, Minnesota, New Hampshire, New Jersey, North Dakota, Rhode Island, and Vermont.

Source: Market and Economic Research, Portland Cement Association, Old Orchard Road, Skokie, Illinois.

1.2 THE CEMENT INDUSTRY IN THE NEVADA/UTAH MARKET AREA

The regional market has been greatly enlarged beyond the Nevada/Utah area. This enlarged Nevada/Utah market area encompasses the following 11 western states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Production data for these 11 states are presented in Table 1.2-1. The data is reported on a district basis, as defined by the Bureau of Mines.

The production of portland cement within the 11 western states generally accounts for about 20 to 25 percent of the nation's total production. California is the only large producer located in the 11 western states, with historical production ranging from 7.3 to 9.5 million tons per year. The district of Colorado, Arizona, Utah, and New Mexico is the second largest producing area of the West. Although the district covers a large area, its production in 1978 totaled only 3.9 million tons. In 1978, 1.8 million tons of portland cement were produced in the state of Washington, which makes it the second largest producing state in the west. Relatively small production comes from other districts within the 11 western states. The district of Wyoming, Montana, and Idaho produced approximately 1.1 million tons in 1978 while production from Oregon and Nevada totaled about one million tons in 1978.

Cement production in the West has followed the same general increased trend exhibited by the nation as a whole, reaching a peak i. 1973 of 16.4 million tons. The recession of 1974 and 1975 caused production to drop to 15.0 and 13.7 million tons, respectively. The recovery from the recession brought about an increase in cement production in the West. In fact, the 1978 production of 17.2 million tons exceeded the previous high reached in 1973 by approximately 5.0 percent.

The historical consumption of portland cement in the Nevada/Utah market area is outlined in Table 1.2-2. Consumption in the total market area has increased from 11,614,000 tons in 1960 to 19,065,000 in 1979, an overall increase of approximately 62.4 percent. Consumption in the 11 western states has been increasing at an average annual compounded growth rate of 2.6 percent.

Similar to the national pattern, the greatest decline in the use of cement occurred during the recession of 1974-75. Consumption dropped to 15,066,000 tons in 1974 from the previous high of 16,514,000 in 1973. A more abrupt decline occurred in 1975, dropping to 13,461,000 tons, some 3,053,000 tons less than the 1973 high. The subsequent economic recovery helped cement use to increase dramatically, with the 1979 level surpassing the previous 1973 high by approximately 2,551,000 tons.

Of the 11 western states, California is by far the largest single consumer of cement. In 1979 California accounted for 50.1 percent of the total cement in the market area. Other states that accounted for a substantial portion in 1979 were: (1) Washington, 9.7 percent; (2) Arizona, 9.4 percent; and (3) Colorado, 8.0 percent. Although California and Washington are the two largest consumers, their total proportion has steadily declined, partially due to the rapid growth of other states in the West.

Table 1.2-1. Nevada/Utah market area production of Portland cement by district, 1960-1978.

Year	Wyoming, Montana, And Idaho	Colorado, Arizona, Utah, And New Mexico	Oregon And Nevada	Washington	California	Total
1960	490	2,238	_[1]	1,550[2]	7,498	11,776
1961	524	2,581	_[1]	1,393[2]	7,738	12,236
1962	576	2,550	_[1]	1,352[2]	8,239	12,717
1963	680	2,549	_[1]	1,466[2]	8,664	13,359
1964	688	2,413	_[1]	1,550[2]	9,019	13,670
1965	677	2,222	704	1,143	8,491	13,237
1966	694	2,191	804	1,166	8,519	13,374
1967	655	2,063	638	1,106	7,905	12,367
1968	718	2,274	680	1,189	8,849	13,710
1969	880	2,263	657	1,189	9,542	14,531
1970	845	2,598	740	1,254	9,412	14,849
1971	942	2,954	840	1,324	9,105	15,165
1972	956	3,145	831	1,426	9,392	15,750
1973	1,047	3,441	908	1,462	9,502	16,360
1974	1,092	3,351	916	1,389	3,202	14,950
1975	1,005	3,295	858	1,379	7,211	13,748
1976	1,044	3,524	912	1,391	7,892	14,763
1977	1,118	3,858	904	1,636	9,040	16,556
1978	1,058	3,899	1,006	1,880	9,315	17,158

T3700/10-2-81

[1]Production data for Oregon included in Washington's total; no production data for Nevada until 1965.

[2]Washington's production includes Oregon from 1960-1964.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

Table 1.2-2. Nevada/Utah market area consumption of portland cement (in thousands of tons), 1960-1979.

Year	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Total
1960	909	6,642	763	254	203	158	451	582	393	1,061	198	11,614
1961	1,017	7,108	888	212	204	184	490	562	475	1,027	192	12,359
1962	951	7,495	898	205	243	300	441	572	537	937	207	12,786
1963	869	7,956	895	215	282	393	547	600	472	982	224	13,435
1964	811	8,275	819	215	303	340	519	574	475	1,009	239	13,579
1965	627	7,932	946	272	281	319	531	804	491	1,111	200	13,514
1966	682	7,957	909	255	265	274	512	805	426	1,490	184	13,759
1967	673	7,180	863	212	205	219	442	642	356	1,385	185	12,362
1968	835	8,391	928	325	279	254	536	681	386	1,257	184	14,056
1969	973	8,745	906	476	390	316	427	685	459	1,152	172	14,701
1970	1,060	8,552	1,041	508	319	301	429	644	419	1,136	186	14,595
1971	1,364	8,530	1,239	438	306	413	509	704	495	1,216	167	15,381
1972	1,544	8,491	1,425	414	242	402	566	806	652	1,091	194	15,827
1973	1,711	8,608	1,593	429	282	467	595	835	686	1,104	204	16,514
1974	1,385	7,779	1,339	418	269	369	586	825	684	1,167	245	15,066
1975	1,086	6,847	1,162	393	253	366	540	774	691	1,032	317	13,461
1976	1,111	7,303	1,197	511	335	359	543	794	920	1,168	418	14,659
1977	1,480	8,414	1,406	509	349	510	518	852	899	1,360	389	16,786
1978	1,610	8,760	1,511	459	362	612	632	968	900	1,631	385	17,830
1979	1,800	9,544	1,516	471	335	610	583	976	922	1,846	462	19,065

T3993/10-2-81/F

Sources: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook for data from 1960-1976; and Portland Cement Association, Market and Economic Research Department, Portland Cement Consumption for data from 1977-1979.

The states with the fastest growing cement consumption are Nevada, Utah, and Wyoming. Cement consumption increased by over 286 percent in Nevada from 1960 through 1979. On an annual basis, consumption increased average of 7.4 percent contrasted with 2.6 percent for the area as a whole. Cement use within the state of Utah increased rapidly from 393,000 tons in 1960 to 922,000 tons in 1979, a 134.6 percent increase. From 1960 through 1979, the annual growth rate has averaged 4.6 percent, substantially higher than the market area's growth rate. Consumption of cement within Wyoming has also shown rapid growth. Overall, consumption increased by 133.3 percent from 1960-79. Although the growth exhibited by the above three states has been substantial, combined they accounted for only 10.5 percent of the area's total consumption (see Table 1.2-3).

The growth in consumption was lowest in New Mexico--from 1960 through 1979 cement consumption increased by only 29.3 percent. During this period, consumption grew at only a 1.4 percent yearly rate.

California was the only other state whose annual growth rate for cement consumption was below the market area's average. This is to be expected because California is by far the largest single consumer in the market area.

Table 1.2-4 shows the average shipments of portland cement by type of customers for 1976 through 1978. Ready-mixed concrete accounted for a substantial proportion of total consumption in the Nevada/Utah market area, ranging from 69.3 to 75.3 percent depending upon the state or district. This was slightly greater than the national average. Other major customers were concrete product manufacturers, highway contractors, other contractors, and building materials dealers.

The average price of cement from 1960 through 1978 for the Nevada/Utah market area is denoted in Table 1.2-5 and graphically illustrated in Figure 1.2-1. Each of the districts set forth in this table are characterized by different rates of price growth over the period from 1960 through 1978. California experienced the largest price change with increases from $17.24 per ton in 1960 to $50.97 in 1978. On an annual basis, prices increased an average of 6.2 percent. Closely following California was the district composed of Oregon and Nevada. Prices within this area experienced an annual increase of approximately 5.7 percent from 1960 through 1978.

Prices increased at an annual rate of 5.5 percent in Washington and 5.4 percent over the 1960-1978 period in the district encompassing Colorado, Arizona, Utah, and New Mexico. The district of Wyoming, Montana, and Idaho experienced the smallest increase in cement prices, only 4.9 percent per year during the 1960-1978 time period. As of 1978, cement prices were highest in Oregon and Nevada and lowest in Wyoming, Montana, and Idaho. Overall, the price of cement in the Nevada/Utah market area increased from $17.72 in 1960 to $49.51 in 1978. Prices increased at an average annual compounded rate of 5.9 percent. Similar to the price movements at the national level, the major increase in the price of cement occurred after 1973.

The cement capacity within each of the western states covers a wide range from a low of 200,000 tons to a high of over 10 million tons (see Table 1.2-6). California has by far the largest cement capacity of any western state. Its annual

Table 1.2-3. Nevada/Utah market area consumption growth rates, 1960-1979.

State	Percent Increse 1960-1979	Average Annual Compounded Growth Rate 1960-1979
Arizona	98.0	3.7
California	43.7	1.9
Colorado	98.7	3.7
Idaho	85.4	3.3
Montana	65.0	2.7
Nevada	286.1	7.4
New Mexico	29.3	1.4
Oregon	67.7	2.8
Utah	134.6	4.6
Washington	74.0	3.0
Wyoming	133.3	4.6
Total Area	64.2	2.6

T4994/10-14-81

Source: Sources for data for the above table taken from U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, and Portland Cement Association, Market and Economic Research Department, Portland Cement Consumption.

Table 1.2-4. Nevada/Utah market area portland cement shipments by type of customer, 1976-1978 average (percent).

District Origin	Building Materials Dealers	Concrete Product Manufacturers	Ready-Mixed Concrete	Highway Contractors	Other Contractors	Federal, State and Other Government Agencies	Miscellaneous
Wyoming, Montana, and Idaho	2.9	6.7	73.1	2.8	10.2	0.4	3.8
Colorado, Arizona, Utah, and New Mexico	6.3	10.4	69.3	4.6	5.6	0.1	3.8
Washington	3.6	13.7	70.9	3.9	4.6	0.2	3.0
Oregon and Nevada	5.7	9.7	75.3	4.6	4.3	0.1	0.3
California	9.1	13.2	70.3	2.5	3.7	0.1	1.0

T3995/10-15-81

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1976, Cement preprint from 1977, Minerals Yearbook, and Mineral Industry Surveys, Cement in 1978.

Table 1.2-5. Nevada/Utah market area average value[1] of portland cement shipped by district origin, 1960-1978 (dollars/ton).

Year	Colorado, Arizona, Utah, and New Mexico	Wyoming, Montana, and Idaho	Oregon and Nevada[2]	Washington	California	Weighted Average
1960	18.14	19.36	18.73	18.73	17.24	17.72
1961	18.03	19.36	18.62	18.62	16.81	17.40
1962	17.66	19.15	18.78	18.78	16.97	17.40
1963	17.77	18.62	18.99	18.99	16.97	17.40
1964	18.03	18.57	19.10	19.10	16.92	17.45
1965	17.93	18.41	18.99	18.99	16.97	17.50
1966	17.98	17.77	19.21	18.99	17.13	17.61
1967	18.41	18.30	19.21	19.52	17.45	17.93
1968	18.51	18.73	19.05	19.36	16.97	17.66
1969	19.26	18.51	20.38	19.05	17.93	18.41
1970	20.80	18.99	20.54	20.32	18.62	19.26
1971	21.62	19.69	21.28	20.66	18.64	19.63
1972	22.43	21.43	22.15	21.67	20.06	20.93
1973	24.09	21.45	21.97	22.32	21.49	22.18
1974	27.40	26.04	25.53	26.40	25.48	26.04
1975	33.56	31.40	35.86	35.45	31.74	32.74
1976	37.18	36.08	40.94	39.31	37.19	37.52
1977	41.74	41.48	45.06	44.65	43.82	43.30
1978	46.92	45.38	51.01	49.24	50.97	49.51

T3996/10-02-81/F

[1]Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances; less all freight charges to customer; less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.

[2]Prior to 1965, Nevada did not produce cement and Oregon and Washington were combined into one district. Since 1964, Oregon and Nevada were combined into one district and Washington was reported separately.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook and Mineral Industry Surveys Cement in 1978.

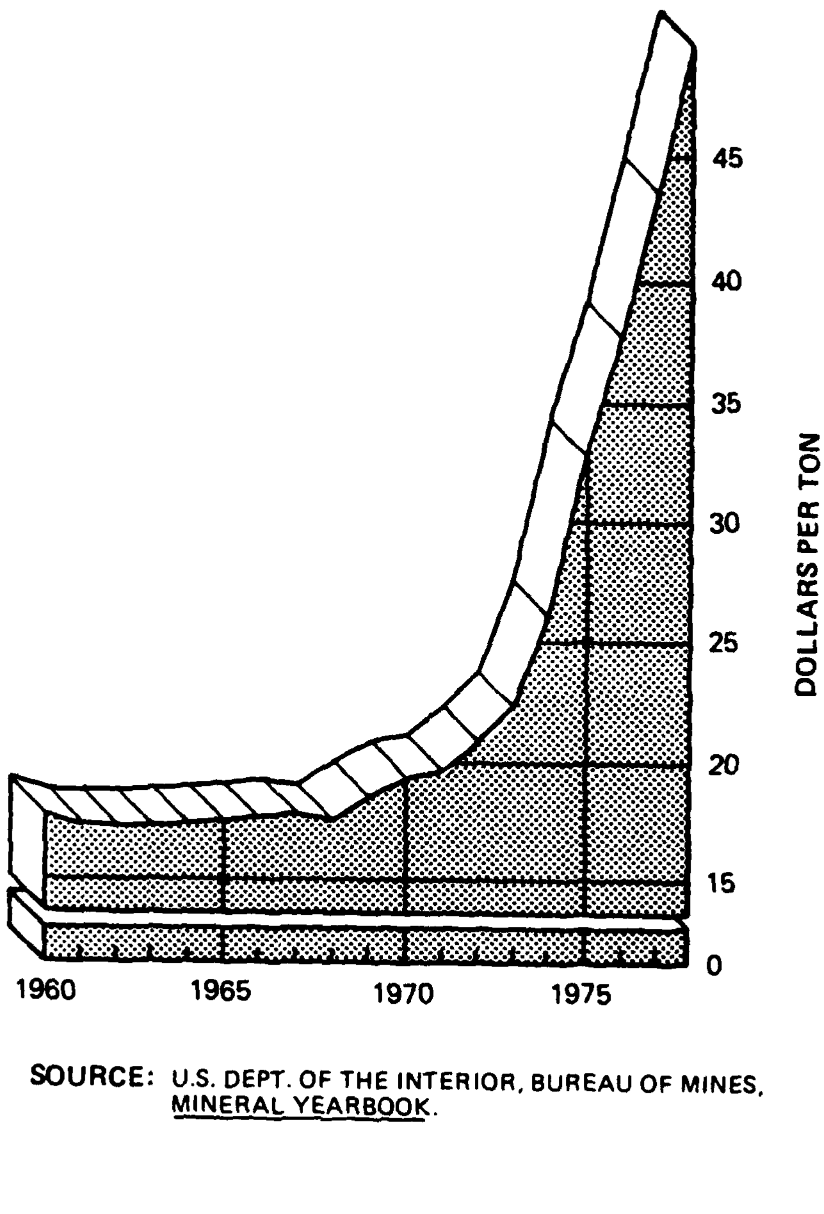


Figure 1.2-1. Nevada/Utah market area weighted average mill value of portland cement.

Table 1.2-6. Nevada/ Utah market area cement plant capacity by state.

State	Capacity Rank in United States	Cement Capacity (1,000 Tons)
Arizona	18	1,790
California	2	11,385
Colorado	21	1,356
Idaho	38	425
Montana	32	650
Nevada	37	430
New Mexico	35	500
Oregon	24	1,180
Utah	28	770
Washington	17	1,857
Wyoming	39	225
Area Total		20,568

T3997/9-13-81/F

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1980.

capacity of 11,385,000 tons ranks it second in the nation, only 868,000 tons less than number-one-ranked Texas. With plant expansion scheduled for completion in 1981, California will soon become the largest cement-producing state. Cement capacity in California comprises approximately 55 percent of the total capacity existing in the 11 western states. Other states exhibiting a cement plant capacity of over one million tons annually are: Washington, 1,857,000 tons; Arizona, 1,790,000 tons; and Colorado, 1,356,000 tons. Overall, the combined capacity of the 11 western states totals 20,568,000 tons annually compared to the 19,065,000 tons consumed in 1979. In order for the western states to be self-sufficient in cement, all plants would have had to operate near capacity in 1979. California has the largest number of producing cement plants in the West. Five plants in California have the capacity to produce over one million tons annually. Arizona is the only other western state with a plant having the capacity to produce over one million tons per year.

Table 1.2-7 denotes the primary type of fuel utilized by each plant. Due primarily to the rising costs of oil and gas, the cement industry has been moving toward the use of coal wherever feasible. As indicated in Table 1.2-7, only a few plants use strictly oil and/or gas as a primary fuel. The majority of the cement plants in the West are coal fueled. Figure 1.2-2 sets forth the location of all cement producing plants in the West.

Planned capacity changes indicate that during 1981, cement capacity should increase by 3,064,000 tons, of this, 1,694,000 tons of capacity will be located in the state of California. The remaining 460,000, 300,000, and 620,000 tons of additional capacity will be in Colorado, Wyoming, and Utah, respectively (see Table 1.2-8). The only capacity expansion planned for 1982 is 500,000 tons at Monolith, California. Capacity expansions planned for 1982 includes 461,000 tons in Utah. The Utah plant will provide a substantial increase (79 percent) to the state's current capacity of 780,000 tons.

Table 1.2-9 sets forth the capacity utilization of the districts comprising the Nevada/Utah market area from 1973 through 1978. Over the six-year period, the districts of Wyoming, Montana, and Idaho have averaged the highest capacity utilization rate of 87.7 percent. Other districts and their respective six-year average capacity utilization rates are: California, 76.8 percent; Washington, 71.0 percent; Oregon/Nevada, 66.8 percent; and the district encompassing Colorado, Arizona, Utah, and New Mexico, 66.1 percent.

1.3 THE CEMENT INDUSTRY IN THE TEXAS/NEW MEXICO MARKET AREA

The Texas/New Mexico market area reflects a geographical market with characteristics similar to the Nevada/Utah market area. The enlarged Texas/New Mexico market area encompasses the following states: Arizona, Arkansas, Colorado, Kansas, Louisiana, Mississippi, Missouri, New Mexico, Oklahoma, Texas, and Utah.

Table 1.3-1 sets forth the production of portland cement for districts and states in the Texas/New Mexico market area. This market area accounts for approximately 25 to 30 percent of the total production of portland cement in the nation.

Table 1.2-7. Nevada/Utah market area by plant capacity.

State	Capacity (1,000 Tons)	Plant Name	Primary Fuel	Location
Arizona	1,100	California Portland	Coal	Rillito
	620	Phoenix	Coal	Clarkdale
California	1,598	Kaiser	Coal	Permanente
	1,179	Riverside	Coal	Oro Grande
	1,150	California Portland	Coal	Mojave
	1,130	Southwestern	Oil/Gas	Victorville
	1,015	Kaiser	Gas	Lucerne Valley
	900	Riverside	Coal	Riverside
	780	California Portland	Coal	Colton
	630	Flintkote	Coal	San Andreas
	610	General	Coal	Lebec
	500	Monolith	Coal	Monolith
	395	Lone Star	Oil	Davenport
	280	Flintkote	Coal	Redding
	146	Riverside[1]		Riverside
Colorado	885	Ideal	Coal/Oil	Portland
	431	Martin Marietta	Coal	Lyons
	325	Ideal	Coal/Gas	Boettcher
Idaho	210	Oregon Portland	Coal	Inkom
Montana	330	Ideal	Coal	Trident
	320	Kaiser	Gas	Montana City
Nevada	430	Centex	Coal	Fernley
New Mexico	505	Ideal	Coal	Tijeras
Oregon	500	Oregon Portland	Coal	Durkee
	360	Oregon Portland	Coal/Oil	Lake Oswego
	130	Oregon Portland	Coal	Huntington
Utah	420	Lone Star	Coal/Oil/Gas	Salt Lake City
	360	Ideal	Coal/Gas	Devils Slide
Washington	752	Lone Star	Coal	Seattle
	490	Ideal	Coal	Seattle
	350	Columbia	Coal/Oil/Gas	Bellingham
	215	Lehigh	Coal	Metaline Falls
Wyoming	200	Monolith	Coal	Laramie
Area Total	19,246			

T3998/10-15-81

[1]Manufacturer of white cement.

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1979.

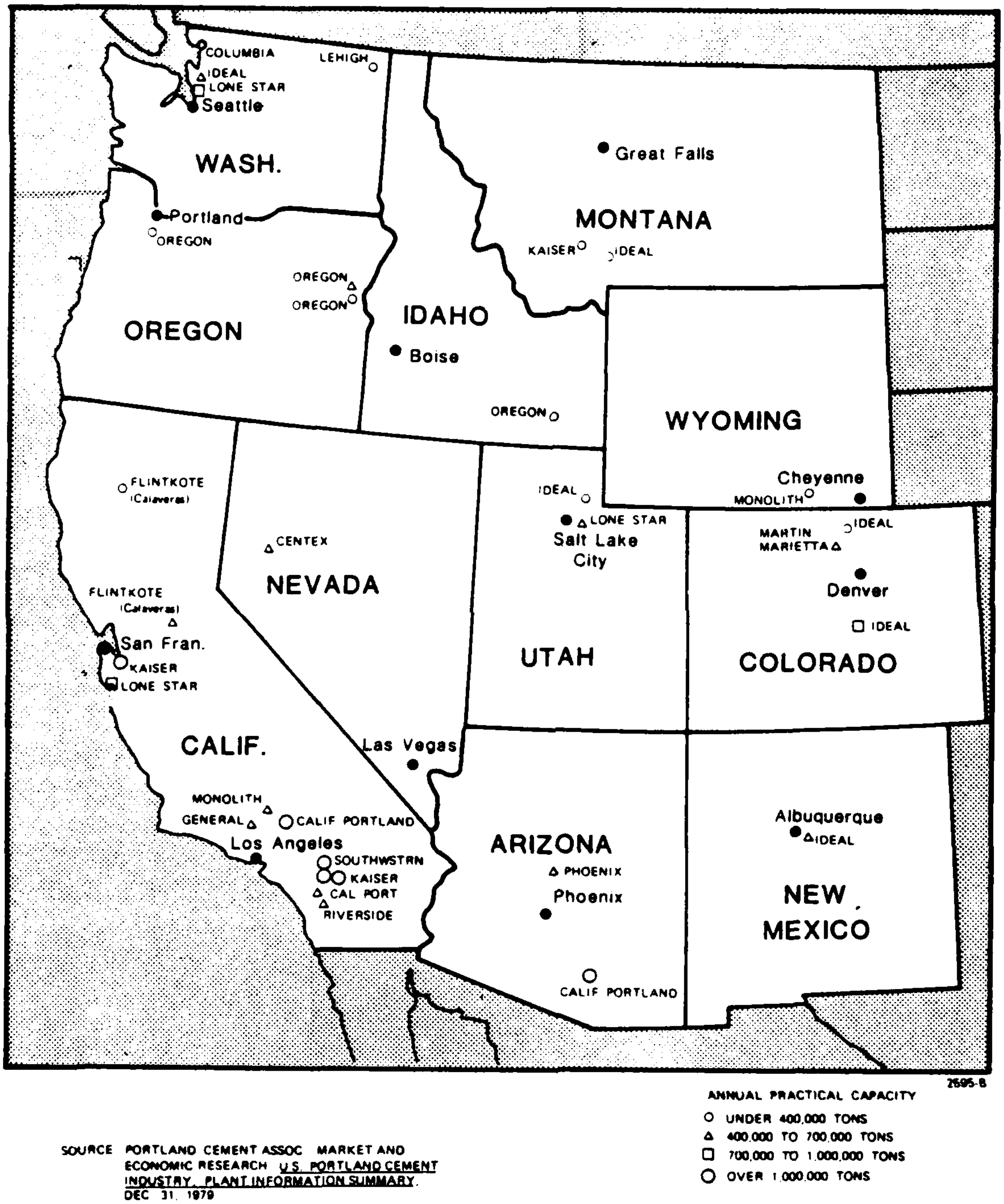


Figure 1.2-2. Locations of cement producing plants in the western United States.

Table 1.2-8. Nevada/Utah market area announced cement/clinker capacity changes, as of December 31, 1980.

Company Name	Projected Operational Date	Location	Capacity (thousands of tons)		
			Existing	Projected	Net Difference
Flintkote	1981	Redding, Calif.	264	600	336
Calif Portland	1981	Mojove, Calif.	1,090	2,090	1,000
Kaiser	1981	Permanente, Calif.	1,512	1,520	8
Lone Star	1981	Davenport, Calif.	396	744	348
Ideal	1981	Ft. Collins, Colo.	0[1]	460	460
Martin Marietta	1981	Leamington, Utah	0	620	620
Monolith	1981	Laramie, Wyo.	196	496	300
Monolith	1982	Monolith, Calif.	500	1,000	500
Kaiser	1983	Lucerne Valley, Calif.	964	1,425	461

T3999/10-2-81/F

[1] Existing kilns retired in 1980.

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1980.

Table 1.2-9. Portland cement capacity utilization (by percent) for the Nevada/Utah market area, 1973-1978.

Year	Wyoming, Montana, and Idaho	Colorado, Arizona Utah, and New Mexico	Oregon and Nevada	Washington	California
1973	86.3	72.4	65.6	64.7	83.1
1974	89.6	62.3	66.1	61.5	74.3
1975	83.1	57.9	61.9	65.0	65.3
1976	85.6	62.1	65.8	67.2	73.0
1977	93.2	71.7	65.2	78.0	82.0
1978	88.2	70.3	75.9	89.7	83.3
Six Year Average	87.7	66.1	66.8	71.0	76.8

T3729/10-2-81

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1979.

Table 1.3-1. Portland cement production for the market area of Texas/New Mexico, 1969-1978 (thousands of tons).

Year	Louisiana and Mississippi	Missouri	Kansas	Oklahoma and Arkansas	Texas	Colorado, Arizona, Utah, and New Mexico	Total
1960	1,366	2,370	1,503	1,345	4,359	2,238	13,181
1961	1,243	2,244	1,566	1,709	4,678	2,581	14,021
1962	1,480	2,301	1,548	1,802	4,970	2,550	14,651
1963	1,583	2,386	1,550	2,124	5,479	2,549	15,671
1964	1,701	2,331	1,567	2,144	5,600	2,413	15,756
1965	1,696	2,627	1,669	2,274	5,784	2,222	16,272
1966	1,739	2,623	1,724	2,353	5,919	2,191	16,549
1967	1,681	2,798	1,696	2,325	6,067	2,063	16,630
1968	1,578	3,723	1,858	2,366	6,421	2,274	18,220
1969	1,427	3,921	1,830	2,421	6,734	2,263	18,596
1970	1,289	3,897	1,687	2,083	6,501	2,598	18,055
1971	1,486	4,144	1,799	2,374	7,138	2,954	19,895
1972	1,602	4,329	1,986	2,604	7,884	3,145	21,550
1973	1,479	4,359	2,036	2,746	8,312	3,441	22,373
1974	1,699	4,298	1,996	2,695	9,961	3,351	24,000
1975	1,330	3,919	1,835	2,232	7,074	3,295	19,685
1976	1,551	4,334	1,950	2,620	7,438	3,524	21,417
1977	1,538	4,551	2,072	2,771	8,223	3,858	23,013
1978	1,586	4,620	2,063	2,774	8,624	3,899	23,566

T3701/10-2-81

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1979.

Texas is the single largest producer within the market area, accounting for approximately 36 percent of the area's total production. The production of cement in Texas has grown rapidly since the early 1960s. In 1960 Texas produced about 4.4 million tons compared to 8.6 million in 1978.

Production within Missouri is the second largest within the Texas/New Mexico market area. Production in Missouri accounted for approximately 17 to 20 percent of the area's total production. Similar to Texas, Missouri has shown a fairly rapid increase in cement production. In 1960 Missouri produced about 2.4 million tons compared to 4.6 million in 1978.

Other producing districts and their 1978 production were: Colorado, Arizona, Utah, and New Mexico, 3.9 million tons; Oklahoma and Arkansas, 2.8 million tons; Kansas, 2.1 million tons; and Louisiana and Mississippi, 1.6 million tons.

Similar to the West and the nation as a whole, cement production in the market area increased gradually throughout the 1960s reaching 22,373,000 tons in 1973. During the recession in 1974, production increased to 24 million tons. In 1975 production finally declined to 19,685,000 tons. With the recovery, production gradually increased from the 1973 level reaching 23,566,000 tons in 1978.

The consumption of portland cement by states within the Texas/New Mexico market area is set forth in Table 1.3-2.

Cement consumption within the total market area increased from 12,206,000 tons in 1960 to 22,910,000 tons in 1978, an overall increase of approximately 88 percent. The average annual compounded growth rate in consumption for the Texas/New Mexico area from 1960 through 1979 was approximately 3.4 percent compared to a growth rate of 2.6 for the Nevada/Utah market area.

Unlike the western and national trends, the recession of 1974 and 1975 did not significantly affect the consumption of cement in the Texas/New Mexico market area. In fact, consumption declined by only 1.5 million tons in 1974 and then increased by approximately 1.3 million tons in 1975. The growth in consumption throughout the 1960-1979 period can be characterized as gradually increasing.

Texas is not only the largest cement consuming state within the market area, but also one of the fastest growing states with respect to consumption. Since 1960 consumption within Texas has increased at an average annual compounded growth rate of approximately 4.5 percent. Table 1.3-3 sets forth the overall and annual growth rates in consumption for the states within the Texas/New Mexico market area.

Other states with rapidly growing annual consumptive growth rates were Utah, Colorado, and Arizona.

The consumption of portland cement by customer category is set forth in Table 1.3-4. Similar to the West and the nation as a whole, the majority of cement shipments are used for ready-mixed concrete. However, individual districts vary substantially, with the ready-mix market receiving as low as 55.0 percent in Louisiana and Mississippi and as high as 76.3 percent in Missouri of cement shipments from 1976 and 1978.

Table 1.3-2. Texas/New Mexico market area consumption of portland cement (thousands of tons), 1960-1979.

Year	Arizona	Arkansas	Colorado	Kansas	Louisiana	Mississippi	Missouri	New Mexico	Oklahoma	Texas	Utah	Total
1960	909	487	763	953	1,505	625	1,445	451	878	3,797	393	12,206
1961	1,017	558	888	1,085	1,479	677	1,516	490	1,048	4,054	475	13,287
1962	951	574	898	1,002	1,669	696	1,657	441	1,117	4,305	537	13,847
1963	869	669	895	945	1,713	752	1,690	547	1,336	4,628	472	14,516
1964	811	716	819	965	1,956	772	1,930	519	1,159	4,917	475	15,039
1965	627	850	946	948	2,123	792	1,958	531	1,294	4,958	491	15,518
1966	682	922	909	964	2,184	885	1,735	512	1,009	5,075	426	15,303
1967	673	834	863	894	2,213	794	1,759	442	989	5,068	356	14,885
1968	835	834	928	1,077	2,358	822	1,825	536	1,136	5,331	386	16,068
1969	973	723	906	1,063	2,199	832	1,800	427	1,369	5,650	459	16,401
1970	1,060	615	1,041	964	1,902	814	1,747	429	1,236	5,413	419	15,640
1971	1,364	783	1,239	983	2,179	789	2,026	509	1,216	6,159	459	17,742
1972	1,544	838	1,425	1,048	2,358	929	1,798	566	1,398	6,786	652	19,342
1973	1,711	866	1,593	1,126	2,335	968	1,876	595	1,419	6,821	686	19,996
1974	1,385	883	1,339	1,146	2,365	911	1,715	586	1,474	6,359	684	13,847
1975	1,086	802	1,162	1,122	2,191	813	1,635	540	1,186	6,130	691	17,358
1976	1,111	885	1,197	1,229	2,486	830	1,723	543	1,262	6,469	920	18,655
1977	1,480	930	1,406	1,230	2,536	943	1,791	618	1,592	7,873	899	21,298
1978	1,610	952	1,511	1,233	2,861	1,019	2,040	632	1,660	8,469	900	22,887
1979	1,800	888	1,516	1,292	2,744	947	1,848	583	1,669	8,701	922	22,910

T4008/10-2-81/F

Sources: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook for data from 1960-1976; and Portland Cement Association, Market and Economic Research Department, Portland Cement Consumption for data from 1977-1979.

Table 1.3-3. Texas/New Mexico market area consumption growth rates, 1960-1979.

State	Percent Increase 1960-1979	Average Annual Compounded Growth Rate 1960-1979
Arizona	98.0	3.7
Arkansas	82.3	3.2
Colorado	98.7	3.7
Kansas	35.6	1.6
Louisiana	82.3	3.2
Mississippi	51.5	2.2
Missouri	27.9	1.3
New Mexico	29.3	1.4
Oklahoma	90.1	3.4
Texas	129.2	4.5
Utah	134.6	4.6
Total Area	87.7	3.4

T4009/10-02-81/F

Source: Sources for data for the above table taken from U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, and Portland Cement Association, Market and Economic Research, Portland Cement Consumption.

Table 1.3-4. Texas/New Mexico market area portland cement shipments by type of customer, 1976-1978 average (percent).

District Origin	Building Materials Dealers	Concrete Product Manufacturers	Ready-Mixed Concrete	Highway Contractors	Other Contractors	Federal, State and Other Government Agencies	Miscellaneous
Colorado, Arizona, Utah, and New Mexico	6.3	10.4	69.3	4.6	5.6	0.1	3.8
Oklahoma and Arkansas	7.0	9.3	63.9	12.9	5.1	0.1	1.6
Kansas	6.0	6.9	71.3	6.5	4.7	--	4.4
Louisiana and Mississippi	10.5	7.5	55.0	6.3	12.7	5.1	2.9
Missouri	2.4	9.5	76.3	10.3	1.4	--	0.1
Texas	7.8	9.3	61.8	3.7	12.6	1.1	3.6

T4010/10-15-81

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1976, Cement, preprint from the 1977 Minerals Yearbook, and Mineral Industry Surveys, Cement in 1978.

Other customer categories showed similar variation, but generally other large consumers included (1) highway contractors, (2) concrete product manufacturers, (3) other contractors, and (4) building materials dealers.

The average price of portland cement in the Texas/New Mexico market area from 1960 through 1978 is set forth in Table 1.3-5 and graphically illustrated in Figure 1.3-1.

Texas experienced the largest price change, with prices increasing from $17.34 per ton in 1960 to $45.55 in 1978. On an average annual compounded basis, prices increased approximately 5.5 percent per year from 1960 through 1979. Over the same period (1960-1978), prices in the district encompassing the states of Colorado, Arizona, Utah, and New Mexico and the Oklahoma/Arkansas district increased at an annual rate of 5.4 and 5.2 percent, respectively. The smallest increase in prices over the 18-year period was experienced in Missouri--from 1960 through 1978, prices increased on the average of 4.0 percent per year. The price of cement in the overall Texas/New Mexico market area increased from $17.56 per ton in 1960 to $42.77 in 1978, an average annual compounded growth rate of approximately 5.1 percent.

The cement production capacity of each of the states within the Texas/New Mexico market area is set forth in Table 1.3-6. Texas has the largest cement capacity within the market area and the nation. Capacity of 10,318,000 tons in Texas accounts for 37.6 of the total capacity within the market area. Missouri is another state which has a substantial cement capacity. Currently, plants in Missouri have the capacity to produce 4,981,000 tons annually, ranking the state sixth in the nation. Other states with plants having a relatively large cement capacity include Kansas with 2,386,000 tons and Oklahoma with 1,960,000 tons. Within the Texas/New Mexico market area there are eight states with a cement capacity exceeding one million tons per year.

The combined capacity within the Texas/New Mexico market area totals 27,440,000 tons compared to consumption of 22,910,000 tons in 1979. Table 1.3-7 sets forth the cement capacity of each plant within the states comprising the market area.

It is not surprising that Texas has the largest number of producing cement plants in the market area. What is unusual is that only one plant can produce over 1 million tons per year. Missouri, which ranks second in production within the Texas/New Mexico market area, has seven producing plants with two producing over 1 million tons annually.

Table 1.3-7 also sets forth the primary fuel of each producing plant. Because of the rising costs associated with oil and gas, when feasible, cement plants have switched to coal as a primary fuel. Most of the plants within the Texas/New Mexico market area are fueled by coal, although the use of gas is more extensive than in the West. Figure 1.3-2 sets forth the location of all cement producing plants in the Texas/New Mexico market area.

Planned capacity changes during 1981 would increase cement capacity by 2,251,000 tons. The new plant in Texas should provide an additional 235,000 tons of capacity. With an expansion of the Marguette plant in Cape Girardeau, capacity in Missouri should increase by 936,000 tons. Also, an expansion in Colorado of 460,000

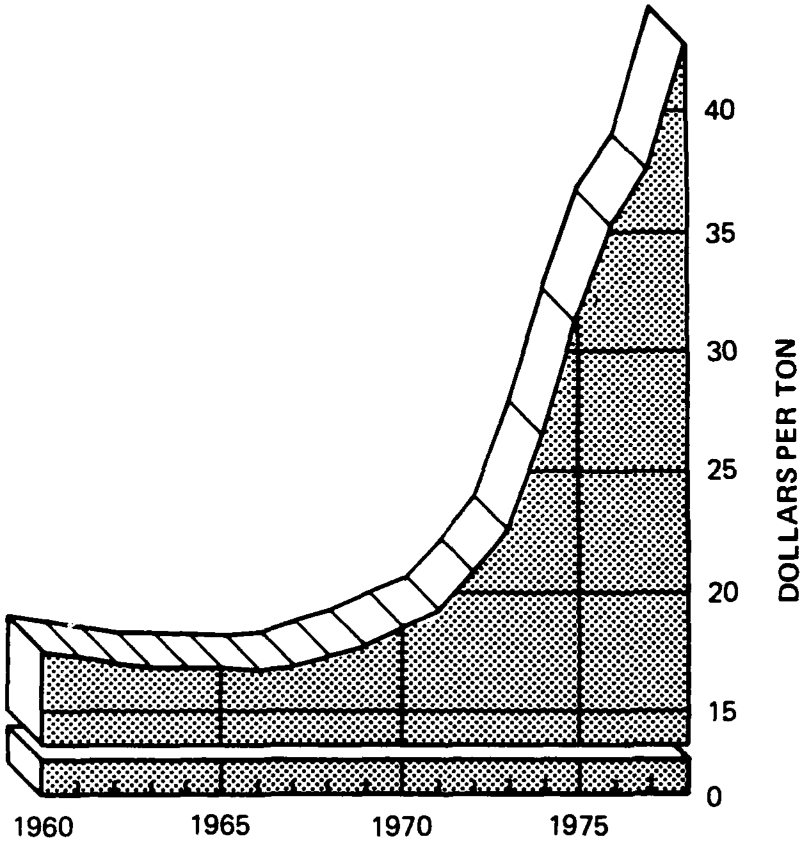
Table 1.3-5. Texas/New Mexico market area average value[1] of portland cement shipped by district origin, 1960-1978 (dollars/ton).

Year	Colorado, Arizona, Utah, and New Mexico	Oklahoma and Arkansas	Kansas	Louisiana and Mississippi	Missouri	Texas	Weighted Average
1960	$18.14	$16.44	$17.02	$17.66	$18.35	$17.34	$17.56
1961	18.03	16.55	16.97	16.86	18.51	17.13	17.40
1962	17.66	15.48	16.60	16.86	18.35	16.86	17.08
1963	17.77	15.59	16.44	16.97	17.88	16.97	16.97
1964	18.03	15.64	16.28	16.70	18.30	16.76	16.97
1965	17.93	15.16	16.28	17.08	18.35	16.86	16.97
1966	17.98	21.07	16.12	16.86	17.77	16.76	16.86
1967	18.41	15.91	15.37	16.86	18.41	16.55	16.92
1968	18.51	15.64	16.44	17.40	18.89	16.60	17.24
1969	19.26	16.01	16.01	17.66	18.57	17.40	17.61
1970	20.80	17.66	16.28	19.58	16.12	19.26	18.35
1971	21.62	18.68	17.31	19.63	17.18	19.48	19.04
1972	22.43	19.43	18.76	20.53	18.91	21.97	20.76
1973	24.09	21.55	20.82	23.91	21.79	22.76	22.55
1974	27.40	26.10	24.20	29.09	25.30	26.84	26.48
1975	33.56	30.14	30.04	32.22	29.34	31.24	31.09
1976	37.18	33.98	33.16	34.74	32.85	36.69	35.20
1977	41.74	35.76	36.05	36.16	33.51	39.11	37.59
1978	46.92	41.18	37.79	43.06	37.17	45.55	42.77

T4011/10/2/81

[1]Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances; less all freight charges to customer; less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook and Mineral Industry Surveys Cement 1978.



SOURCE: U. S. DEPT. OF THE INTERIOR, BUREAU OF MINES
MINERAL YEARBOOK.

3732-A-2

Figure 1.3-1. Texas/New Mexico market area weighted average mill value of portland cement.

Table 1.3-6. Texas/New Mexico market area cement plant capacity by state.

State	Capacity Rank in United States	Cement Capacity (1,000 Tons)
Arizona	18	1,790
Arkansas	22	1,345
Colorado	21	1,356
Kansas	14	2,347
Louisiana	30	750
Mississippi	29	751
Missouri	5	4,646
New Mexico	35	500
Oklahoma	16	1,975
Texas	1	12,253
Utah	28	770
Area Total		28,483

T4012/9-13-81/F

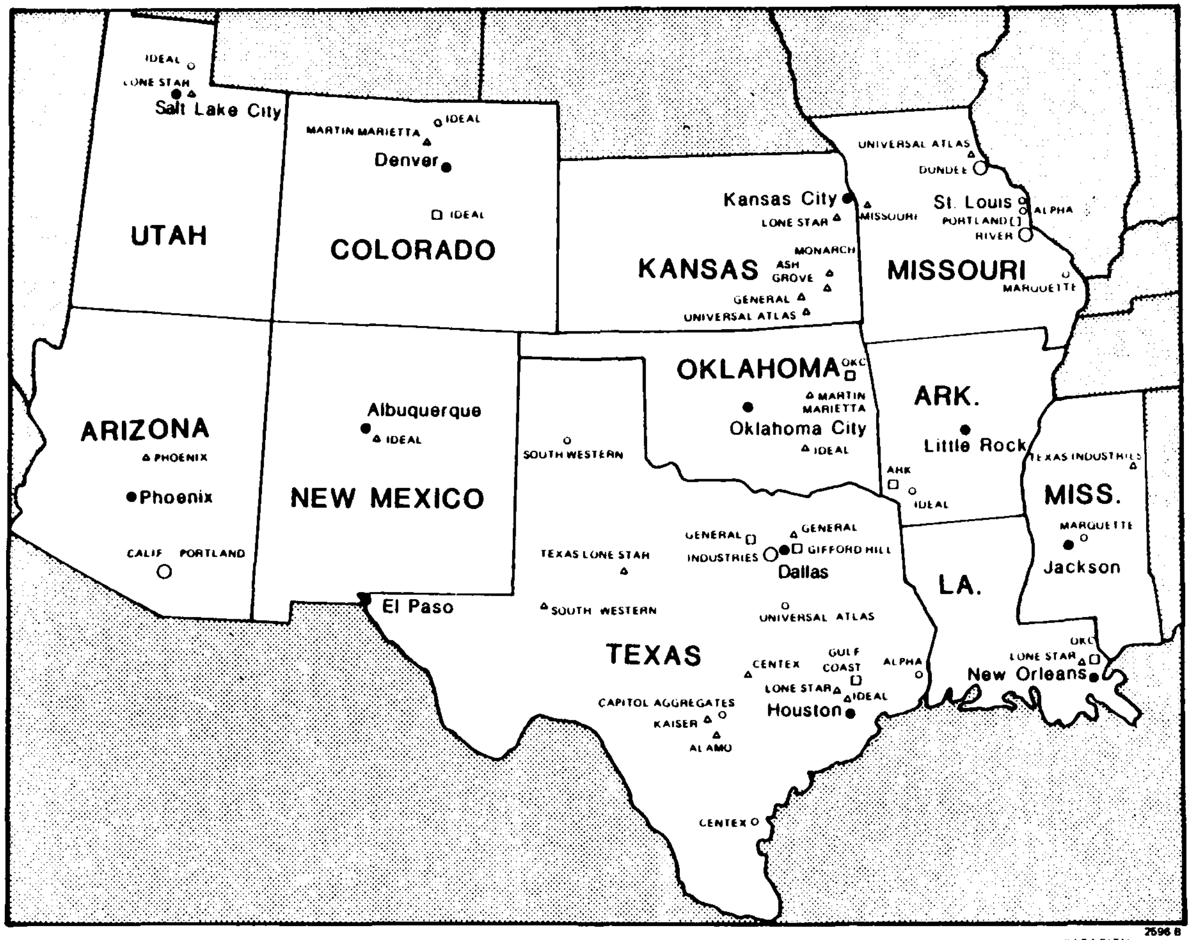
Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary December 31, 1980.

Table 1.3-7. Texas/New Mexico market area by plant capacity.

State	Capacity (1,000 Tons)	Plant Name	Primary Fuel	Location
Arizona	1,100	California Portland	Coal	Rillito
	620	Phoenix	Coal	Clarkdale
Arkansas	850	Arkansas Cement	Coal	Foreman
	395	Ideal	Gas	Okay
Colorado	885	Ideal	Coal/Oil	Portland
	431	Martin Marietta	Coal	Lyons
	325	Ideal	Coal/Gas	Boettcher
Kansas	600	Monarch	Coal/Gas	Humboldt
	516	Ash Grove	Coal	Chanute
	451	Lone Star	Coal	Bonner Springs
	412	Universal Atlas	Gas	Independence
	407	General	Coal	Fredonia
Louisiana	750	OKC	Coal	New Orleans
	414	Lone Star	Gas	New Orleans
Mississippi	525	Texas Industries	Gas	Artesia
	215	Marquette	Coal/Oil/Gas	Brandon
Missouri	1,260	Dundee	Coal	Clarksville
	1,150	River	Coal	Selma
	752	Missouri Portland	Coal	St. Louis
	625	Universal Atlas	Coal	Hannibal
	564	Missouri Portland	Coal	Kansas City
	350	Marquette	Coal	Cape Girardeau
	280	Alpha	Coal	St. Louis (Lemay)
New Mexico	505	Ideal	Coal	Tijeras
Oklahoma	710	OKC	Coal	Pryor
	630	Martin Marietta	Coal	Tulsa
	620	Ideal	Coal	Ada
Texas	1,500	Texas Industries	Coal	Midlothian
	900	Gulf Coast	Coal	Houston
	846	Gifford-Hill	Coal	Midlothian
	731	General	Coal	Fort Worth
	642	Centex	Coal	Buda
	620	Ideal	Coal/Gas	Houston
	550	Southwestern	Coal	Odessa
	545	Lone Star	Coal	Maryneal
	526	Lone Star	Gas	Houston
	490	Kaiser	Coal	San Antonio
	475	General	Coal/Gas	Dallas
	434	Alamo Cement Co.	Coal/Gas	Cementville
	355	Capital Aggregates	Coal/Gas	San Antonio
	352	Universal Atlas	Gas	Waco
	330	Southwestern	Coal/Oil/Gas	El Paso
	325	Alpha	Coal	Orange
	320	Centex	Coal	Corpus Christi
	220	Southwestern	Gas	Amarillo
Utah	420	Lone Star	Coal/Oil/Gas	Salt Lake City
	360	Ideal	Coal/Gas	Devils Slide
Area Total	27,440			

T4013/10-2-81

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1979.



SOURCE PORTLAND CEMENT ASSOC. MARKET AND ECONOMIC RESEARCH, U.S. PORTLAND CEMENT INDUSTRY, PLANT INFORMATION SUMMARY, DEC 31, 1979

ANNUAL PRACTICAL CAPACITY
- ○ UNDER 400,000 TONS
- △ 400,000 TO 700,000 TONS
- □ 700,000 TO 1,000,000 TONS
- ◯ OVER 1,000,000

Figure 1.3-2. Locations of cement producing plants in the Texas/New Mexico market area.

tons is expected in 1981 (see Table 1.3-8). Capitol Aggregates in Texas has announced plans to expand its capacity by 562,000 tons, but the projected operational date is unknown.

Overall, Kansas plants have had the highest capacity utilization of 87.2 percent. The six-year average set forth in Table 1.3-9 also indicates that plants in Missouri show a high utilization (the highest in the nation), having averaged 79.1 percent from 1973 through 1978. The lowest capacity utilization rate of 66.1 percent is found in the plants within the district encompassing the states of Colorado, Arizona, Utah, and New Mexico.

Table 1.3-8. Texas/New Mexico market area announced cement/clinker capacity changes, as of December 31, 1980.

Company Name	Projected Operational Date	Location	Capacity (thousands of tons) Existing	Projected	Net Difference
Alamo Cement	1981	San Antonio, Texas	415	650	235
Ideal	1981	Ft. Collins, Colo.	0[1]	460	460
Martin Marietta	1981	Leamington, Utah	0	620	620
Marquette	1981	Cape Girardeau, Mo.	0[1]	936	936
Capitol Aggregates	Unknown	San Antonio, Texas	338	900	562

T4014/10-2-81/F

[1]Existing kilns retired in 1980.

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1980.

Table 1.3-9. Portland cement capacity utilization, Texas/New Mexico market area, 1973-1978 (percent).

Year	Louisiana and Mississippi	Missouri	Kansas	Oklahoma and Arkansas	Texas	Colorado, Arizona, Utah, and New Mexico
1973	79.5	90.4	95.1	80.9	83.9	72.4
1974	64.2	83.4	92.0	78.3	79.2	62.3
1975	50.2	76.1	78.3	64.6	71.1	57.9
1976	70.7	83.8	83.8	75.6	76.5	62.1
1977	77.1	87.3	88.5	80.9	84.3	71.7
1978	79.6	89.4	85.5	80.4	79.3	70.3
Six Year Average	70.2	85.1	87.2	76.8	79.1	66.1

T3730/10-2-81/a

Source: U.S.Department of the Interior, Bureau of Mines, Minerals Yearbook, 1979.

2.0 PRICE IMPACTS ON CEMENT ASSOCIATED WITH THE CONSTRUCTION OF THE M-X SYSTEM

This section forecasts production and consumption of portland cement for the previously defined Nevada/Utah and Texas/New Mexico market areas from 1980 through 1989. Inherent in any forecast is a margin of error, and this margin generally increases as the forecasting period increases. Therefore, these forecasts should serve only as a general indication of future values of production, consumption, and prices.

2.1 FORECASTING TECHNIQUE AND PREDICTIVE MODEL

The forecasting technique used in this section is that of ordinary least-square regressions utilizing several variables: independent variables plotted with respect to dependent variables.

After numerous regressions stipulating various independent variables, three independent or predetermined variables were selected: (1) the real gross national product (GNP) ("real" in this sense represents constant 1972 dollars); (2) a fuel index; and (3) time.

The selection of the real gross national product was based on its correlation with the real value of construction contracts in each of the market areas. The very strong association between the real value of construction and the consumption of cement, as previously discussed, serves as a predictor of consumption.

As was also discussed earlier, fuel costs represent over one-third of the total manufacturing costs associated with the production of cement. Therefore, a fuel index was included because of the energy-intensive nature of the cement industry. The fuel index used in estimating the equations represented an average of the indices (reported by the Bureau of Labor Statistics in the "Consumer Price Index") for (1) fuel oil and coal, and (2) gas and electricity.

Time was selected as a nonspecific indicator of movements in the dependent variables. Other variables, such as population and wage rates, did not prove as significant as the time variable nor did they add as much to the forecasting ability of the predictive equations.

The consumption and production variables used in the study represented the actual combined consumption and production totals for the states included under each market area. In the same way that production and consumption data were aggregated into a market area total, the value of construction contracts represent an aggregated total for each market area.

The price variable used in this study represented the mill value on a per ton basis in real, or 1972, dollars. (Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances; less all freight charges to customer; less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.)The price variable was derived by weighing each district's value by its respective shipments thereby arriving at a weighted average mill value for each market area.

The historical values of the above variables were employed in several regressions covering the period from 1965 through 1978. The regressions were prepared in linear, natural log, and semilog forms utilizing different combinations of the variables. Regressions utilizing the linear form of estimation exhibited a better fit with respect to the significance of the coefficients and the R^2 values, which represent the proportion of the variation between the dependent and independent variables.

The general form of the predictive equations and their respective R^2 values for the Nevada/Utah market area is as follows:

$$X_1 = a + b\,GNP + c\,Time \qquad R^2 = 0.87 \qquad (1)$$

$$X_2 = d + e\,X_1 + f\,X_3 \qquad R^2 = 0.87 \qquad (2)$$

$$X_3 = g + h\,(X_4 - X_2) + i\,Fuel \qquad R^2 = 0.84 \qquad (3)$$

$$X_4 = j + k\,X_1 + l\,Fuel \qquad R^2 = 0.84 \qquad (4)$$

Where: X_1 = value of construction contracts (1972 dollars)

X_2 = consumption (tons)

X_3 = mill value per ton (1972 dollars)

X_4 = production (tons)

GNP = gross national product (1972 dollars)

Time = time variable (years)

Fuel = fuel index

The operational form of the general equations (1) through (4) are:

1. $$X_1 = a + b\,GNP + c\,Time \qquad (5)$$

2. $$X_2 = d + e\,a + e\,b\,GNP + e\,c\,Time + f\,X_3 \qquad (6)$$

3. $$X_3 = \frac{g + h\,X_4 - h\,d - h\,e\,a - h\,e\,b\,GNP - h\,e\,c\,Time + i\,Fuel}{1 + hf} \qquad (7)$$

4. $$X_4 = j + k\,a + k\,b\,GNP = k\,c\,Time + l\,Fuel \qquad (8)$$

The estimated coefficients for the preceding equations are set forth in Table 2.1-1. The numbers in parentheses represent the "T" statistics. The "T" statistic, computed by dividing the estimated coefficient by its standard error, indicates the significance of the estimated coefficient.

Table 2.1-1. Nevada/Utah market area estimated coefficients and "t" statistics.

Coefficients	Estimated Values	"t" Statistics
a	-29,390	--
b	44.815	(3.59)[1]
c	-820.24	(-1.99)[1]
d	9,680	--
e	0.56258	(-2.62)[1]
f	-155.238	(-2.62)[1]
g	15.10	--
h	-0.0029407	(-1.59)[2]
i	0.056128	(7.27)[1]
j	7,561	--
k	0.53568	(5.66)[1]
l	-8.7476	(1.81)[1]

T4016/10-2-81(a)

[1]Significantly different from zero at the 5 percent level of significance.

[2]Significantly different from zero at the 10 percent level of significance.

Significance computed under a one-tailed test.

Source: Frank K. Stuart & Associates.

The general form of the estimated equations for the Texas/New Mexico market area and their respective R^2 values are set forth below:

1.	$X_1 = a + b\ GNP + c\ Time$	$R^2 = 0.93$	(10)
2.	$X_2 = d + e\ X_1 + f\ X_3$	$R^2 = 0.97$	(11)
3.	$X_3 = g + h\ (X_4 - X_2) + i\ Fuel$	$R^2 = 0.90$	(12)
4.	$X_4 = j + k\ X_1 + l\ Time + m\ Fuel$	$R^2 = 0.89$	(13)

Where:

X_1 = value of construction contracts (1972 dollars)

X_2 = consumption (tons)

X_3 = mill value per ton (1972 dollars)

X_4 = production (tons)

GNP = gross national product (1972 dollars)

Time = time variable (years)

Fuel = fuel index

The operational form of the general equations (10) through (13) are:

$$X_1 = a + b\ GNP + c\ Time \qquad (14)$$

$$X_2 = d + e\ a + e\ b\ GNP + e\ c\ Time + f\ X_3 \qquad (15)$$

$$X_3 = \frac{g + h\ X_4 - h\ d - h\ e\ a - h\ e\ b\ GNP - h\ e\ c\ Time + i\ Fuel}{1 + h\ f} \qquad (16)$$

$$X_4 = j + k\ a + k\ b\ GNP + k\ c\ Time + l\ Time + m\ Fuel \qquad (17)$$

The operational form of the predictive equations estimated for the Texas/New Mexico market area is the same as that specified for the market area of Nevada/Utah with the exception of the use of the time variable in the Texas/New Mexico production equation.

The estimated coefficients and their respective "T" statistics for the Texas/New Mexico market area are set forth in Table 2.1-2.

Table 2.1-2. Texas/New Mexico market area estimated coefficients and "t" statistics.

Coefficients	Estimated Values	"t" Statistics
a	-34,484	--
b	48.335	(4.12)[1]
c	-683.907	(-1.77)[2]
d	10,526	--
e	0.65094	(13.42)[1]
f	-131.281	(-1.78)[2]
g	17.884	--
h	-0.00061497	(-2.63)[1]
i	0.040916	(9.96)[1]
j	13,095	--
k	0.41781	(2.39)[1]
l	544.66	(2.61)[1]
m	-25.460	(-2.11)[1]

T4017/10-2-81(a)

[1]Significantly different from zero at the 5 percent level of significance.

[2]Significantly different from zero at the 10 percent level of significance.

Significance computed under a one-tailed test.

Source: Frank K. Stuart & Associates.

The estimated equations for both market areas indicated a strong, highly significant positive correlation between movements in real GNP and the value of construction contracts. The inclusion of the time variable provided additional predictive ability in both of the area's equations although its significance in both areas was not as great as the GNP variable.

Change in the consumption variable for both market areas was specified as being related to the change in the real value of construction contracts and the real price of cement. For both the Nevada/Utah and Texas/New Mexico market area, the estimated equations indicated that as the real value of construction contracts increased, so did consumption. The equation also indicated that as the real price of cement increased, consumption or demand would decrease. Both coefficients behaved in a manner consistent with economic theory.

Production was used as the dependent variable with its changes associated with movement in the real value of construction contracts, the fuel index, and time in only the Texas/New Mexico equation. The specifications of the estimated equation for production resulted from numerous regressions utilizing other variables such as price and consumption. It was felt that the above specification captured the influence of both consumption and price through the use of the construction variable. The use of price as an independent variable resulted in negative estimated coefficients indicating that production and prices operated in an inverse relationship. Although this may be the case, given rising prices dampening demand, and thereby resulting in a reduction in production, the influence of demand in the equation was chosen to be estimated through the use of the construction variable.

Because of the highly energy-intensive nature of the cement industry, the fuel index was included in the production equation. The estimated coefficient for the fuel variable indicates that as fuel costs rise, production would decline other things being equal. Time was also included in the production equation (but only for Texas/New Mexico) as a nonspecific indicator of other factors which influence the production of cement. Two explanatory variables were used in the estimated equation specifying price as the dependent variable: (1) the difference in a market area between production in a particular time period and consumption in the same period, and (2) the fuel index.

The first variable associated with price movements, production less consumption, was used in the forecast equation under the following assumption: if an area's production exceeded its consumption, a dampening effect would occur on the price; when consumption exceeded production, upward pressure on the price would occur. In the equation employing price as the dependent variable, the estimated coefficient of the production-less-consumption variable proved to be highly significant in the Texas/New Mexico market area and less significant in the Nevada/Utah market area. The estimated coefficient carried a negative sign, indicating that the price would fall when production exceeded consumption and that the price would rise when consumption exceeded production.

The estimated price equations for the Nevada/Utah and Texas/New Mexico market area have respective Durbin-Watson statistics of 1.760 and 1.541. The Durbin-Watson statistic for the Nevada/Utah market area indicates that under a one-tailed test at the 5 percent significance level there is no autocorrelation in the disturbance or error terms. This statistic for the Texas/New Mexico area also indicates zero autocorrelation, but because the statistic roughly equals the upper bounds of the significant limits, there is a possibility of inconclusive evidence about any autocorrelation between the disturbance or error terms.

The virtually nonexistent linear relationship between the independent variables, "production less consumption" and fuel, in both price equations indicates that multicollinearity is not a problem.

Historically, the Texas/New Mexico market area is an area where production exceeds consumption while the Nevada/Utah area is an area where consumption generally exceeds production. It should also be noted that the Texas/New Mexico market area has historically had relatively lower mill value prices than the Nevada/Utah market area.

The inclusion of the fuel index in the price equation is based on the energy-intensive nature of the cement industry. Because fuel costs represent a large proportion of the total manufacturing costs of cement, rising fuel costs would result in an upward pressure on cement prices. The estimated coefficient proved to be highly significant and its positive sign indicated that increasing fuel costs would increase the price of cement.

With the general and operational estimated equations set forth above, future values of the independent variables were estimated.

The difficulty in projecting growth in the gross national product for the next 10 years is apparent; such long-term forecasts usually have little reliability. Fortunately, the objective here is to estimate the impacts on cement prices associated with the construction of the M-X systems. Therefore, the projected values of GNP are not as critical.

Given the recessionary nature of the present economy, short-term forecasts for 1980 estimate a slowdown or decline in the growth of real GNP. Fortune magazine projects a decline in real GNP of 2.0 percent (Fortune, 1980) while others, such as the brokerage firm of Goldman-Sachs, project an overall growth in real GNP of 0.7 percent. A zero growth rate for real GNP in 1980 has been assumed.

Following a slowdown or recessionary period, real growth for the next year or two exceeds the average long-term growth rate. The faster growth experienced in this recovery period usually depends upon the severity of the recession. Given the assumption of a no-growth situation in real GNP in 1980, and assuming the current recession lasts only one year, growth in 1981 should be slightly greater than the average growth in real GNP. The historical growth rate in real GNP was 3.2 percent annually from 1970-1979. It is assumed the growth in GNP will be 5.2 percent in 1981 and 3.2 percent from 1982 through 1989.

Although fuel costs have dramatically increased since 1973, the cement industry has continually adjusting to these high costs by increasing its use of coal and becoming more efficient in its use of energy. For instance, 6.73 million BTUs were utilized in 1970 in the production of one ton of cement compared to 6.59 and 6.31 in 1975 and 1976, respectively (Portland Cement Association, 1978). Because of the responsiveness of the cement industry to higher fuel costs, the fuel index from 1980 through 1989 has been adjusted to increase at a rate of 8.5 percent per year over the 1979 total of 330.42. Values for the projected variables are set forth in Table 2.1-3.

Given the projected estimated values for the independent variables, forecasts of the real value of construction contracts, production, mill prices, and, ultimately, consumption can be determined by use of the estimated equations.

It should be kept in mind that the equations used to forecast the above variables are based on historical relationships. Therefore, the forecasted values are based on the assumption that past structural relationships will remain the same throughout the 1980-1989 period. Furthermore, the forecasts exhibit a smoother growth than that which has characterized the past, due in part to the smoothed forecasts of the independent variables. Past relationships between the general economy and the cement industry are strong, therefore, movements in the economy will most assuredly affect the cement industry. It is beyond the scope of this study to forecast, with any reasonable degree of accuracy, the exact year-to-year change in the independent variables. Therefore, it is assumed that a smoother growth yields smoother forecast values. Furthermore, the primary concern is with the impact on prices associated with changes in the production-consumption relationship, not absolute levels.

2.2 PRODUCTION AND CONSUMPTION PROJECTIONS FOR THE NEVADA/UTAH MARKET AREA

The forecasted values of construction contracts, production, consumption, and price for the Nevada/Utah market area are noted in Table 2.2-1. Throughout the 1980-1989 period, consumption is estimated to exceed production much the same as it has in the past. The forecasted values suggest that consumption will increase at an annual compounded rate of 3.32 percent, reaching a high in 1989 of approximately 22.3 million tons. It is estimated that production will increase from 16.0 million tons in 1980 to almost 21.0 million tons in 1989. Prices are also expected to sharply increase, mainly because of increasing fuel costs. For instance, the real price in 1978 was $32.56 per ton while forecasted values reach $52.66 in 1989. (This report was prepared using 1972 dollars to be consistent with the source data. 1972 dollars can be converted to 1980 dollars (the base year used in the EIS) by multiplying by 1.7653.) While the increase is substantial (a 62 percent increase in the real price of a commodity over 11 years), it should be recalled that, as a result of the energy crisis, the real price of cement in the Nevada/Utah market area increased from $20.93 in 1973 to $32.56 in 1978, an overall increase of 56 percent in just five years.

2.3 PRODUCTION AND CONSUMPTION PROJECTIONS FOR THE TEXAS/NEW MEXICO MARKET AREA

The forecasted values for the Texas/New Mexico market area are set forth in Table 2.3-1. Consumption is projected to surpass production during the 1980s. This forecast reflects the strong growth in construction that has occurred in the area from 1965-1978 and projects its continuance.

Table 1.2-3. Nevada/Utah market area consumption growth rates, 1960-1979.

State	Percent Increase 1960-1979	Average Annual Compounded Growth Rate 1960-1979
Arizona	98.0	3.7
California	43.7	1.9
Colorado	98.7	3.7
Idaho	85.4	3.3
Montana	65.0	2.7
Nevada	286.1	7.4
New Mexico	29.3	1.4
Oregon	67.7	2.8
Utah	134.6	4.6
Washington	74.0	3.0
Wyoming	133.3	4.6
Total Area	64.2	2.6

T3994/10-2-81(a)

Source: Sources for data for the above table taken from U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, and Portland Cement Association, Market and Economic Research Department, Portland Cement Consumption.

Table 2.2-1. Nevada/Utah market area forecasts, 1980-1989.

Year	Value of Construction Contracts[1] (Millions of Dollars)	Production (Thousands of Tons)	Consumption (Thousands of Tons)	Mill Value[1] (Dollars Per Ton)
1980	21,643	16,019	16,614	33.77
1981	24,157	17,099	17,793	35.28
1982	25,497	17,527	18,297	36.89
1983	26,909	17,970	18,822	38.63
1984	28,387	18,421	19,360	40.52
1985	29,942	18,885	19,916	42.57
1986	31,569	19,355	20,485	44.80
1987	33,281	19,838	21,074	47.21
1988	35,069	20,324	21,675	49.82
1989	36,942	20,815	22,288	52.66

T4019/10-2-81/F

[1]Represents real or constant 1972 dollars. These data may be converted to 1980 dollars by multiplying by 1.7653.

Source: Frank K. Stuart & Associates, 1981.

Table 2.3-1. Texas/New Mexico market area forecasts, 1980-1989.

Year	Value of Construction Contracts[1] (Millions of Dollars)	Production (Thousands of Tons)	Consumption (Thousands of Tons)	Mill Value[1] (Dollars Per Ton)
1980	23,770	22,613	22,076	29.88
1981	26,682	23,599	23,771	31.41
1982	28,328	23,989	24,645	32.91
1983	30,051	24,341	25,548	34.57
1984	31,847	24,645	26,475	36.40
1985	33,725	24,899	27,435	38.42
1986	35,680	25,094	28,418	40.63
1987	37,727	25,228	29,431	43.06
1988	39,856	25,289	30,468	45.72
1989	42,077	25,271	31,531	48.63

T4020/10-2-81/F

[1]Represents real or constant 1972 dollars. These data may be converted to 1980 dollars by multiplying by 1.7653.

Source: Frank K. Stuart & Associates, 1981.

Prices in the Texas/New Mexico area are expected to rise rapidly. In 1978, the real price of cement for the area totaled $28.13 per ton compared to $48.63 in 1989, an increase of 73 percent.

2.4 PROJECTIONS OF PRICE IMPACTS

Because the forecasted values are based on the continuation of historical patterns, not much time was spent discussing the forecasts because of their minor importance with respect to the objective. It is accepted that in all probability, these estimates of consumption, production, and construction will not be totally accurate. This is because production capacity as well as growth patterns and demand may vary from their historical patterns. Because of the problem of forecasting such variables ten years into the future, a price equation utilizing a relative production-consumption variable was employed. The price equation, as discussed earlier, was specified in order to determine differences between production and consumption during a time period and also to determine the impact on the price of cement. Therefore, demonstrating the impact of additional demand on the price of cement by using the price equation model is more accurate than trying to establish future values of consumption and production.

By using the price equation model, reasonable estimates resulting from the construction of the M-X system can be provided.

The impacts associated with the construction of the M-X system are based on the Proposed Action, Alternatives 1 through 7, and the two parts of Alternative 8, the split deployment alternative.

DIRECT AND INDIRECT CEMENT REQUIREMENTS (2.4.1)

M-X direct cement requirements data are specified in ETR-31 (Construction) and are summarized in Table 2.4.1-1. In addition to these direct requirements, cement would be used in the construction of indirect infrastructure facilities such as community housing, and industrial and commercial facilities. While direct project requirements can be estimated and scheduled with a reasonable degree of confidence, indirect requirements cannot. This is because indirect requirements would result a variety of individual, corporate, and local government decisions that would be related to Air Force decisions on M-X, but would not be contracted by the Air Force. To estimate indirect requirements, the following approach was taken: The OB portion of the direct requirements includes housing, commercial and industrial facilities, and an airfield; the cement required for these OB complex facilities is expected to approximate the indirect demand with some overestimation resulting from the airfield; thus, indirect requirements are assumed to equal the OB complex direct requirements. Given the price impact levels that occur the basic conclusion of this analysis would not change significantly even if a moderate level of underestimation should occur. This analysis further assumes that indirect requirements occur in the same year as direct requirements. A time lag would reduce the expected level of impacts.

PRICE IMPACTS (2.4.2)

Table 2.4.2-1 summarizes by year the forecast trend price of cement (no project alternative) and the impact related to each alternative. Total price that

Table 2.4.1-1. Direct and indirect M-X-related cement requirements (thousands of tons).

	1982	1983	1984	1985	1986	1987	1988	1989
Proposed Action and Alternatives 1,2,4,6								
OB Complexes	30	64	64	97	81	64	15	0
DDA	0	0	4	225	245	229	258	145
Total Direct	30	64	68	322	326	293	273	145
Total Indirect	30	64	64	97	81	64	15	0
Total	60	128	132	419	407	357	288	145
Alternatives 3, 5								
OB Complexes	30	64	64	97	81	64	15	0
DDA	0	0	16	231	244	233	259	123
Total Direct	30	64	80	328	325	297	274	123
Total Indirect	30	64	64	97	81	64	15	0
Total	60	128	144	425	406	361	289	123
Alternative 7								
OB Complexes	30	60	64	99	82	65	16	0
DDA	0	0	11	175	286	264	248	121
Total Direct	30	60	75	274	368	329	264	121
Total Indirect	30	60	64	99	82	65	16	0
Total	60	120	139	373	450	394	280	121
Alternative 8 (Nevada/Utah)								
OB Complex	24	51	48	46	27	18	0	0
DDA	0	0	7	113	127	129	120	57
Total Direct	24	51	55	159	154	147	120	57
Total Indirect	24	51	48	46	27	18	0	0
Total	48	102	103	205	181	165	120	57
Alternative 8 (Texas/New Mexico)								
OB complex	25	49	49	47	28	19	0	0
DDA	0	0	65	141	126	137	78	5
Total Direct	25	49	114	188	154	156	78	5
Total Indirect	25	49	49	47	28	19	0	0
Total	50	98	163	235	182	175	78	5

T5248/10-2-81/F

Source: HDR Sciences, 1981.

Table 2.4.2-1. Estimated trend and M-X price impacts on cement (in 1972 dollars).[1]

Year	Trend		Impact for Alternatives				
	N/U	T/M	PA,1,2,4,6	3,5	7	8(N/U)	8(T/M)
1981	37.82	33.72	0.00	0.00	0.00	0.00	0.00
1982	39.75	35.36	0.18	0.18	0.04	0.14	0.03
1983	41.84	37.15	0.38	0.38	0.07	0.30	0.06
1984	44.11	39.12	0.39	0.42	0.09	0.30	0.09
1985	46.57	41.27	1.23	1.25	0.23	0.60	0.14
1986	49.23	43.62	1.20	1.19	0.28	0.53	0.11
1987	52.12	46.18	1.05	1.06	0.24	0.49	0.11
1988	55.24	48.98	0.85	0.85	0.17	0.35	0.05
1989	58.64	52.03	0.43	0.36	0.07	0.17	0.00
1990	62.31	55.35	0.00	0.00	0.00	0.00	0.00
1991	66.29	58.96	0.00	0.00	0.00	0.00	0.00

T5249/10-2-81

[1] 1972 dollars may be converted to 1980 dollars by multiplying by 1.7653.

N/U = Nevada/Utah supply area
T/M = Texas/New Mexico supply area
PA = Proposed Action

Source: Frank K. Stuart & Associates, 1981.

would occur with M-X is the sum of the appropriate area trend plus the impact of the appropriate alternative. For example, the total price of a ton of cement in 1982 with the Proposed Action would be $39.75 (Nevada/Utah trend price) plus $0.18 (M-X impact) or $39.93 (total). The peak impact year in Nevada/Utah would be 1985, when M-X-related construction (direct and indirect) could add $1.23 to $1.25 to the price of a ton of cement. While the model output shows slight variation between the two Nevada/Utah full deployment scenarios, these differences are not significant.

Given the greater size and flexibility of the Texas/New Mexico cement industry, the price impacts shown in Table 2.4.2-1 would be substantially less than those in Nevada/Utah. Because of scheduling differences in the two regions, the peak price impact year in Texas/New Mexico would be 1986. For full deployment in either region, price impacts on cement would be concentrated in a four year period, 1985-1988, inclusive. By 1990, M-X would cease to have an impact on cement prices.

Because regional demand for cement for M-X would be less with the split-deployment alternative, price impacts in each region would be less than for the full deployment alternatives. In Texas/New Mexico, these impacts would be small enough that they would probably be within the confidence interval of the model and thus would not be significant.

The above analysis includes both direct and indirect requirements. These could be disaggregated by rerunning the model, or they could be approximated by the following rules of thumb. The price equation for the Nevada/Utah market area indicates that for each additional 100,000 tons required by indirect consumers, the price of cement would increase by an estimated 29 cents per ton. An additional demand requirement of 100,000 tons in the Texas/New Mexico market area is estimated to increase prices by 6 cents per ton.

The small estimated price impacts associated with the construction of the M-X system are not unusual when examined in light of current production and capacity. A basing mode alternative no longer under consideration, the burial trench, was analyzed in Milestone II. If that alternative had been selected, cement price impacts would have been significantly higher than for the current basing mode.

3.0 CONCLUSION

Over an eight year period (1982-1989), the M-X system has been estimated to require a total of about 1.5 million tons of cement for direct needs, and about 0.4 million tons for indirect requirements. The peak-year requirements would occur in 1985 for all alternatives except Alternative 7, when the peak would occur in 1986. To put this into perspective, in 1978 the 11 western states produced a total of 17,158,000 tons of cement. The 1985 peak-year requirement represents, at the most, 2.5 percent of the total production that occurred in the Nevada/Utah area in 1978 (see Table 3-1). If the split-deployment alternative was utilized, the peak annual requirement for cement would represent no more than 1.2 percent of 1978 total production in the West (see Table 3-2).

When the M-X system demand for cement is contrasted with capacity, the amount of cement required by the system becomes an even smaller proportion. For example, the peak annual amount of cement required for the M-X system represents approximately 1.7 and 2.2 percent of the total capacity of all cement plants in the region in 1979.

If capacity additions and expansions, as described in a previous section, proceed as announced, the western states will have the capacity to increase production as follows: (1) 1980 to 1,349,000 tons; (2) 1981 to 1,000,000 tons; and (3) 1982 to 1,688,000 tons. By 1982, if the announced capacity additions occur, the capacity of the western states will increase by approximately 4,037,000 tons. The 1987 peak-year direct requirement associated with the M-X system represents only 1.4 percent of the 1982 projected capacity of the 11 western states.

The cement required by split deployment of the M-X system would represent virtually insignificant amounts when contrasted to the production, capacity and expected capacity of cement plants in the Nevada/Utah and Texas/New Mexico market areas (see Table 3-2).

With the M-X system based in Texas and New Mexico, the peak-year requirement represents only 1.6 percent of the total production within the area in 1978. With respect to 1979 capacity, the peak-year direct requirement accounts for only 1.3 percent (see Table 3-3).

If capacity additions and expansions proceed as announced, the Texas/New Mexico market area will have the capacity to increase production as follows: (1) 1980 to 2,269,000 tons; (2) 1981 to 575,000 tons; (3) 1982 to 2,150,000 tons. By 1982, if the announced capacity additions occur, the capacity of the Texas/New Mexico market area will increase by approximately 4,994,000 tons. The peak-year requirement of 368,000 tons direct or 450,000 tons total represents only 1.1 or 1.4 percent, respectively, of the 1982 expected capacity of the Texas/New Mexico market area.

Under a supply source comprising the 11 western states, the above estimated impacts appear reasonable. The use of a supply area considerably larger than that which normally characterizes the cement industry would incur substantial costs in transporting cement into the basing area, especially if the M-X system is based in Utah/Nevada. For example, the transportation cost of shipping cement to Salt Lake

Table 3-1. 1985 peak year M-X requirements as a percentage of production, capacity, and expected capacity, Nevada/Utah market area.

	Thousands Of tons	Peak Requirements As A Percentage Of	
		Direct	Total
1978 Production	17,158	1.9	2.5
1979 Capacity	19,246	1.7	2.2
1982 Expected Capacity	24,093	1.4	1.8

T4024/9-13-81/F

Source: Frank K. Stuart & Associates, 1981.

Table 3-2. 1985 peak year M-X requirements as a percentage of production, capacity, and expected capacity under split deployment.

	Thousands Of Tons	Peak Requirements As A Percentage Of	
		Direct	Total
1978 Production in Nevada/Utah Market Area	17,158	0.9	1.2
1978 Production in Texas/New Mexico Market Area	23,566	0.8	1.0
1979 Capacity in Nevada/Utah Market Area	19,246	0.8	1.1
1979 Capacity in Texas/New Mexico Market Area	27,440	0.7	0.9
1982 Expected Capacity in Nevada/ Utah Market Area	24,093	0.7	0.9
1982 Expected Capacity in Texas/ New Mexico Market Area	32,516	0.6	0.7

T4025/10-2-81/F

Source: Frank K. Stuart & Associates, 1981.

Table 3-3. 1987 peak year M-X requirements as a percentage of production, capacity, and expected capacity, Texas/New Mexico market area.

	Thousands Of tons	Peak Requirements As A Percentage Of	
		Direct	Total
1978 Production	23,566	1.6	1.9
1979 Capacity	27,440	1.3	1.6
1982 Expected Capacity	32,516	1.1	1.4

T4026/9-13-81/F

Source: Frank K. Stuart & Associates, 1981.

City from Denver by rail totals approximately $1.05 per 100 pounds or about $21.00 per ton. The transportation costs are significantly higher by truck, costing approximately $3.43 per hundred-weight from Denver to Salt Lake City.

A possible mitigating factor to the high cost associated with transporting cement from all 11 western states involves the examination of planned capacity additions. This is most important in the state of Utah.

The consumption of cement in Utah has been increasing at an average rate of approximately 4.6 percent per year since 1965. Although consumption has shown a significant increase over the last 14 years, its growth since 1976 has been minor. Consumption in Utah totaled 919,000 tons in 1976, contrasted to 922,000 tons in 1979, representing an increase of only 0.3 percent. Since 1976, consumption in Utah has averaged approximately 910,000 tons per year.

At the present time there are two cement-producing plants located in Utah, The Portland Cement Company of Utah, which was recently purchased by Lone Star in Salt Lake City, and Ideal's "Devil's Slide" plant, located in Weber Canyon near Ogden, Utah. The largest of the two plants is the Lone Star plant with an annual capacity of 420,000 tons of cement. The Devil's Slide plant currently has a capacity of approximately 360,000 tons per year, thereby providing a total capacity for the state of 780,000 tons annually.

Even under a 100 percent capacity utilization rate, Utah must import additional cement in order to meet its demand. Additional cement is usually obtained from the Ideal cement plant in Portland, Colorado although cement from as far away as Seattle and Trident in Montana has been shipped on occasion to meet Utah's demand. At times, cement from Inkom, Idaho serves as a supply source for the northern region of the state.

With Utah consuming approximately 900,000 tons of cement per year (and having the capacity to produce only 780,000 tons), any additional demand of the magnitude that the M-X system will require would have a significant impact on the availability and price of cement in the state. This, however, is not the expected case. There are plans for the construction of a new cement plant within Utah. Martin Marietta has announced the planned construction of a 620,000 ton per year plant in Leamington, Utah in 1982. This plant will increase Utah's production capacity 79 percent to 1,400,000 tons per year. The addition of only one new plant would have the effect of moving the state from a cement importer to a cement exporter. Table 3-4 has been prepared under the assumption that the consumption of cement in Utah will continue to grow at the 1965-1979 rate of 4.6 percent per year, which is considerably higher than the growth experienced from 1976 through 1979. Included in Table 3-4 is the projected annual cement requirements associated with the M-X system. It appears that with the planned addition of the cement producing plant in Utah, the impact of the M-X system, even if it obtained its cement from Utah alone, would be minimal for the first three years. Not included in the table is an additional 580,000 tons per year from Utah that is in initial planning stages.

This would be the case even given the substantial quantity of cement required for the construction of the 3,000 megawatt Intermountain Power Plant (IPP). Estimates from the IPP Environmental Impact Statement indicate the IPP will

Table 3-4. Consumption and capacity projections for Utah, 1982-1989 (thousands of tons).

Year	Consumption[1]	Capacity[2]	Surplus Capacity	M-X Demand For Cement[3]
1982	1,055	1,400	345	60
1983	1,104	1,400	296	128
1984	1,154	1,400	246	132
1985	1,208	1,400	192	419
1986	1,263	1,400	137	407
1987	1,321	1,400	79	357
1988	1,382	1,400	18	288
1989	1,446	1,400	(46)[4]	145

T4027/10-2-81/F

[1]Assumed to increase at a compounded rate of 4.6 percent from 1979 total consumption of 922,000 tons.

[2]Based on announced plans of cement companies and existing production.

[3]Total demand under the Proposed Action.

[4]Negative value.

Source: Frank K. Stuart & Associates, 1981.

require approximately 240,000 cu yd for buildings and about 90,000 cu yd for footing bases for the transmission line towers. Assuming a five-bag mix for the buildings and a six-bag mix for the transmission lines, the total cement requirements of the IPP would approximate 82,000 tons over the construction period of the project.

The case with Nevada is substantially different, however. In 1979, Nevada consumed approximately 610,000 tons of cement. Consumption within the state has increased dramatically--since 1960, consumption has increased at an average annual compounded rate of 7.4 percent. Currently, only one plant produces cement in Nevada. The plant, located in Fernley, has the capacity to produce 430,000 tons annually and supplies virtually all of northern Nevada with cement. The Fernley plant, with a terminal in Sacramento, also ships to northern California. Cement from northern California also enters the Reno market. Because of the vast distance between Fernley (Reno area) and Las Vegas, southern Nevada is supplied from the southern California area. Although no capacity additions or expansions have been announced for Nevada through 1982, California has announced capacity expansions of 1,692,000 tons. An additional 500,000 tons and 461,000 tons of additional capacity is anticipated in California in 1982 and 1983, respectively.

If the M-X system is constructed in Nevada/Utah, it appears as though the capacity changes projected for California would be able to handle Nevada's increased demand and any over-capacity demand in Utah. This would be the case even if the currently discussed power plant in White Pine County is constructed. For example, current estimates indicate that the Valmy-2 plant planned for construction in Humboldt County during the mid-1980s would require a total of approximately 7,100 tons of cement. Although the Valmy-2 plant is only a 250 megawatt unit, it is unlikely that the power plant planned for White Pine County would require a total demand greater than 14,000 tons.

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