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ECONOMIC INTELLIGENCE REPORT

THE CEMENT INDUSTRY OF THE USSR 1950-60

CIA/RR 155
November 1958

CENTRAL INTELLIGENCE AGENCY

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~~SECRET~~

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S-E-C-R-E-T

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(ORR Project 47.1092)

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FOREWORD

This report is written at a time when the USSR is releasing a considerable amount of new statistics and general information about the cement industry. This new material greatly enhances the coverage of the report but has necessitated numerous revisions. The revision of the 1960 goal for the cement industry gives revised statistics only for production and for the number of new plants to be constructed through 1960, thus making it necessary to include some of the statistics for the original 1960 Plan. The original figures are retained because it is felt that they are still of value in analyzing the industry.

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THE CEMENT INDUSTRY OF THE USSR*
1950-60

Summary

The cement industry of the USSR, although second only to that of the US in total production, has chronically been unable to satisfy the needs of the vigorously expanding Soviet economy for this basic construction material. Through 1955, production of cement increased at about the same rate as other producer goods (excluding machinery), but during 1956-60 it is to increase at one of the highest rates planned for any major industrial commodity. The downward revision of the 1957 and 1960 Plans and the probable underfulfillment of the latter suggest that the shortage of cement will continue to hinder construction at least through 1960 and that the USSR will remain a net importer of cement.

During the Fifth Five Year Plan (1951-55), production of cement increased about 120 percent,** which was a slight overfulfillment of the original plan for the period but a slight underfulfillment of the revised plan. The production plan for 1960 set forth in the Sixth Five Year Plan (1956-60) has already been revised downward. The new plan envisages an increase in production of cement of 131 percent above the level of 1955 and an increase in gross industrial production of 65 percent. This large increase in production of cement is planned to relieve the shortages experienced during the Fifth Five Year Plan, to allow for an increased amount of cement per unit of construction, and to supply the sharply expanding program for precast reinforced concrete.

In the original Sixth Five Year Plan the industry relied for an increase in production of cement primarily on the completion of 27 new plants, which were to be of higher than average capacity, and to a lesser extent on the expansion of production at existing plants. The increase in production was to be accompanied by a doubling of labor productivity, a general lowering of costs,*** and a high degree

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 May 1958.

** The average annual increase in production of cement in the USSR was greater than that achieved in the US during this period, but the gap widened between the total tonnage produced in the two countries.

*** The cement industry reportedly has a higher cost of capital investment in relation to total output costs than any other industry in the USSR, and this cost per ton of output is believed to be increasing.

of regional self-sufficiency in production and consumption. This latter goal was to be attained primarily by building 17 of the new plants in the Eastern Regions.* The revised production goal for 1960, however, calls for the completion of only 16 new plants, or 1 less than was originally planned for the Eastern Regions alone. This will retard the expansion of production, particularly in the Eastern Regions, and will prevent a substantial improvement in regional self-sufficiency by 1960.

In 1956, the first year of the Sixth Five Year Plan, production of cement fell considerably below the modest planned increase, and only 1 of the 5 cement plants scheduled for completion and operation during the year began operating. In 1957 the original plan was lowered considerably, and this new plan was expected to be overfulfilled. The extent of the overfulfillment, however, was less than anticipated, and only 4 of 6 scheduled new plants began operating. The 1958 Plan is low in comparison with the level of production planned for 1960.

The shortcomings of the cement industry as shown in 1956 and 1957 as well as the modest 1958 goal make highly improbable the achievement of even the revised production goal of 52 million tons** for 1960.

The USSR is therefore likely to remain a large net importer of cement from the European Satellites and Communist China in spite of Soviet exports to underdeveloped countries -- which, however, are small.

I. Technical Definitions.

Cement may be defined as any substance capable of binding fragments of solid matter into a solid mass. In this report the word cement refers to hydraulic cement -- that is, cement which is activated by water and will harden or set after water has been added. Cement must be used in concert with aggregate and water to make a

* Including Regions VIII through XII. The Western Regions include Regions I through VII.

50X1
50X1

** Tonnages are given in metric tons throughout this report.

usable material. It may be mixed with sand and gravel to make concrete,* with sand and lime to make masonry cement (mortar), or with asbestos to manufacture asbestos cement products.

The most important and most common hydraulic cement is called portland cement. During the Fifth Five Year Plan, portland and portland slag cement accounted for about 80 to 85 percent of all hydraulic cement produced in the USSR.** Portland cement is produced by burning a finely ground mixture containing limestone, silica, alumina, and iron oxides in certain definite proportions and then grinding the resulting clinker with a small quantity of gypsum. Portland slag cement is composed of clinker and metallurgical slag.*** The raw materials for the clinker are limestone and slag. Gypsum is also added in the final grinding process. The actual manufacturing process of portland cement is illustrated in Figure 1.****

Portland cement may be endowed with special qualities by the addition of small quantities of additives† or by special post-kilning processes. Some of the special types of portland cement are the following: rapid-hardening or high early strength cement (attaining a high degree of strength within 24 hours), sulfate-resisting cement (largely unaffected by certain chemicals), tamponage or oil well cement (used to line oil wells), white or decorative cement, and air-entrained cement (resisting scaling and the effects of temperature changes).

Another important type of hydraulic cement is pozzuolana, or portland-pozzuolana, cement, which is composed of ground portland clinker and pozzuolanic materials.†† It is the third most important type of cement in the USSR, accounting for roughly 10 to 15 percent of total production of cement during 1950-55.**

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* Most cement is used in concrete, which is often incorrectly referred to as cement.

** See Appendix A, Table 21, p. 62, below.

*** Metallurgical slag used in cement manufacture is composed primarily of burned limestone which has been added as a flux in the refining of iron ore.

**** Following p. 4.

† In addition to slag and gypsum, various chemicals may be added in the final grinding process to impart special qualities to the cement or to facilitate grinding.

†† These are predominantly siliceous minerals, which when finely ground can combine with lime in the presence of water. Natural materials include pumice stone and certain shales and clays. Fly ash is also used as a pozzuolana.

II. Problems of Cement in the Soviet Economy.

Numerous statements in the Soviet press indicate that the continuing shortage of cement is a major problem confronting the Soviet economy. The periodical Stroitel'naya gazeta asserted that "the scarcity of cement has become an important hindrance to the industrialization and expansion of construction" and that it was necessary to increase the capacity of the cement industry at a faster rate than the rate for all other branches of the construction industry. 1/* Production of cement has been insufficient for the needs of the Soviet economy for many years. In an attempt to supply the needs of the economy more adequately in 1960, the original Sixth Five Year Plan called for a 145-percent increase above the level of 1955. 2/ The revised plan calls for a 131-percent increase in production of cement and for a 65-percent increase in gross industrial production. 3/ In addition to increasing production of cement, it is planned to improve distribution and to reduce waste. The USSR plans to improve distribution by decreasing the average length of haul, thus easing the burden on the transportation system, especially the railroads.**

Cement is wasted by poor storage and careless hauling. Because of these factors, organizations performing one-third of the construction-installation work in the economy used 702,000 tons more cement in 1955 than was originally allocated in the plan (that is, about 3 percent of the total cement consumed). Again, because of these factors, 290,000 tons more were consumed in the first half of 1956 by 18 ministries and departments than were prescribed in the plan. 4/ In addition, cement is a semiperishable commodity which deteriorates over time because of the absorption of atmospheric moisture. One method used to reduce the losses of cement from deterioration is to ship clinker (which is not perishable) to grinding installations that are located in the immediate areas where consumption of cement is great. 5/

Another major problem confronting the Soviet cement industry is the problem of increasing demand. In the USSR the proportion of cement in concrete*** and the use of concrete in construction are

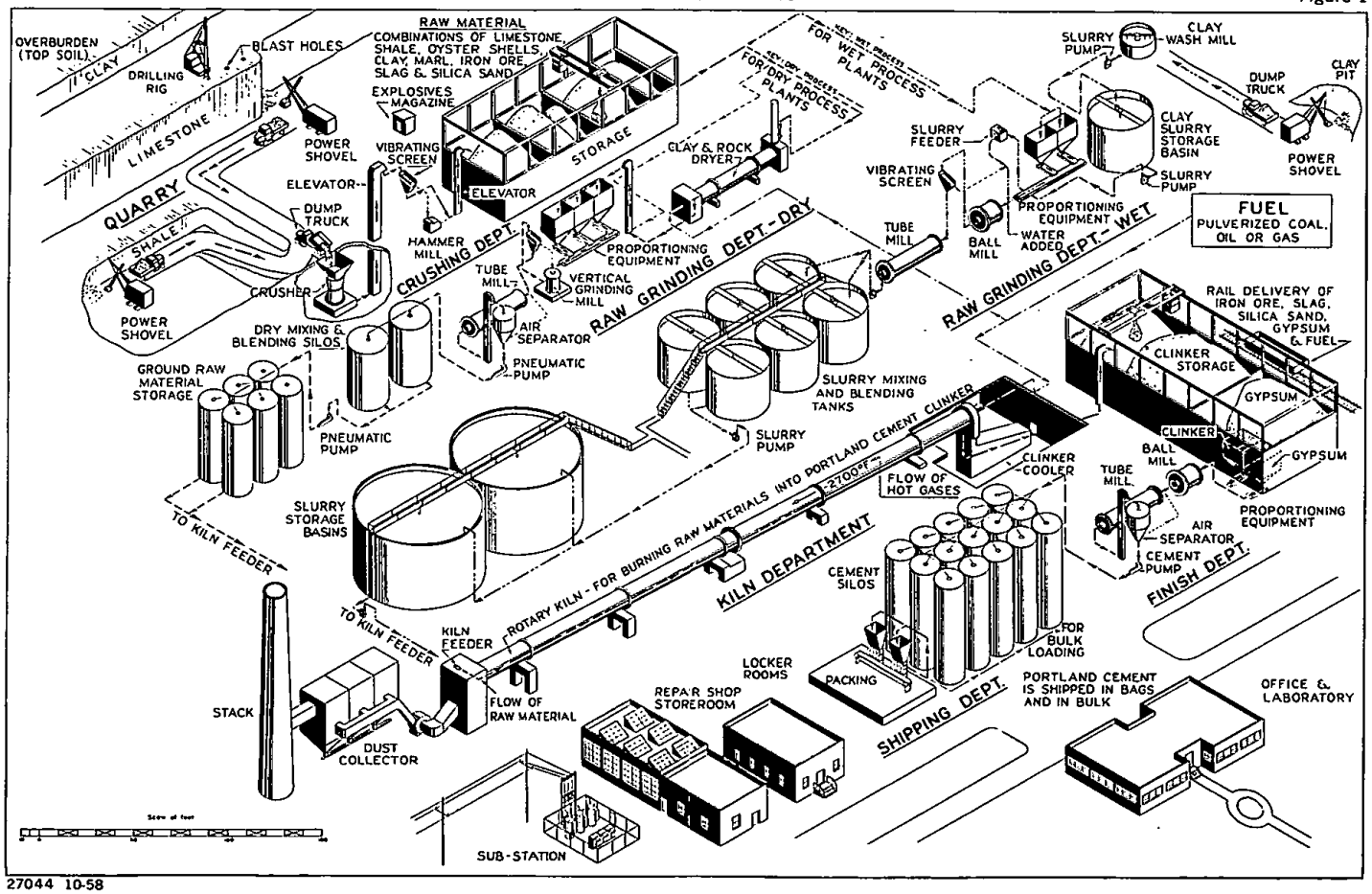
50X1

** For a more complete discussion of this problem, see IX, C, p. 33, below.

*** Cement must be combined with an aggregate to become a usable building material: most of it is combined with sand and gravel to make concrete. A considerably smaller percentage of the total cement produced is mixed with lime and sand to make masonry cement (mortar) or is combined with asbestos to make asbestos-cement products.

FACILITIES REQUIRED TO PRODUCE PORTLAND CEMENT

Figure 1



27044 10-58

increasing. In the latter half of 1954 an average of 300 kilograms (kg) of cement was used to make 1 cubic meter (cu m) of reinforced concrete.* 6/ In the first half of 1955 the average was increased to between 300 and 350 kg, 7/ and again in January 1956 the upper limit of the range was increased to 400 kg per cubic meter. 8/

Consumption of concrete and reinforced concrete in construction is planned to be increased 150 percent in 1960 compared with 1955. 9/ The most dynamic element in this increase is the production of precast reinforced concrete, which by 1960 is to be about 430 percent greater than in 1955. 10/

A good indication of the increasing use of cement in the Soviet economy is the relationship of consumption of cement to the value of construction, as shown in Table 1.

Table 1

Consumption of Cement
per Million Rubles of Construction
in the USSR a/
Selected Periods, 1933-60

Period	Consumption (Metric Tons)	Index (1951-55 = 100)
1933-40 b/	187	83
1951-55 b/	226	100
1960 c/	315	139

a. 11/. In 1 July 1955 rubles.
b. Yearly average for the period.
c. Estimate [redacted] on the basis of the original Sixth Five Year Plan. 50X1

Thus from the period of the Fifth Five Year Plan (1951-55) to 1960 the use of cement per million rubles** of construction is to increase 39 percent. Reasons for the increasing demand for cement are as follows:

* Concrete with steel bars or wire encased in it to give added strength.
** In 1 July 1955 rubles. (Ruble values in this report, except where otherwise indicated, are expressed in current rubles and may be converted to US dollars at the official rate of exchange of 4 rubles to US $1. This exchange rate, however, does not necessarily reflect the true dollar value.)

1. Because of the acute shortage of cement during the Fifth Five Year Plan, the norms for the expenditure of cement had to be decreased. A growth in the ratio after that period would therefore have been necessary even without a change in the techniques of construction.

2. Precast reinforced concrete structural elements are being substituted for metal and wooden structural elements.

3. The range of uses for cement is being increased -- for example, more concrete roads are being constructed.

4. The share of those types of construction for which the cement requirements are relatively high (roads and dams) is increasing more rapidly in relation to other types of construction.

In an attempt partly to offset these increases in the ratio of cement to construction, it is planned to effect economies in the use of cement. One method of economizing requires more careful screening and crushing of sand, gravel, and stone. The resulting higher quality aggregate would permit the use of less cement. 12/ Another means of saving manufactured cement is to substitute more ground slag or lime for cement. 13/

III. Development, 1951-55.

Production of cement in the USSR during the period of the Fifth Five Year Plan (1951-55) continued to be insufficient to fill the needs of the expanding Soviet economy. The annual production plans for 1951 and 1952 were not fulfilled, but a slight overfulfillment of the original Five Year Plan goal was attained. 14/ The plan had called for 1955 production to increase by 120 percent above the level of 1950. 15/ This original goal was slightly overfulfilled, but, in response to the continued shortage of cement, a revised production plan for 1955 was announced which called for a 22-percent increase above the level of 1954, 16/ or a total production of 23.2 million tons of cement. This plan was fulfilled by only 97 percent. Consequently, there were interruptions in construction work on a number of important projects, including 3 important hydroelectric power stations and a heavy forge equipment works, and drilling operations were held up at 2 oilfields. 17/

During 1951-55, production of cement in the USSR increased at an average annual rate of 17.1 percent, so that by 1955 the Soviet cement industry produced about 12.3 million tons more cement than it had produced in 1950. During the same period the US cement industry increased its production at an average annual rate of only 6.5 percent,

but production in 1955 exceeded the level of 1950 by about 14.4 million tons. Thus, although the rate of increase was lower in the US than in the USSR, the tonnage increase of 1955 above the level of 1950 in the US was 17 percent greater than in the USSR.* Production of cement in the USSR, 1940 and 1950-60, and in the US, 1940 and 1950-57, is shown in Table 2** and in Figure 2.***

Because of unsatisfactory construction of cement plants, during the Fifth Five Year Plan the schedule for the introduction of new capacity was not fulfilled in any year. Completion of new plants frequently required from 6 to 8 years, and some of those plants which were completed were so poorly constructed that the structures collapsed. 20/ During this period (1951-55), however, 12 new plants were put into operation.

Better results were apparently obtained in expanding the output of existing plants. For example, in 1952 it was announced that the quarrying and hauling of limestone at cement plant quarries had been 95 percent mechanized and that the quantity and quality of cement produced in existing kilns had been increased. 21/ Modernization of kilns was also part of the extensive program to increase the output of existing plants. For instance, in 1952 and 1953, 68 rotary kilns were to be improved. 22/

The relatively poor results achieved in activating new cement plants compared with raising the output at existing plants were particularly evident in 1955. In that year, about 60 percent of the increase in production of cement was planned to be accomplished by improved utilization of existing plants, and this was planned to account for all of the increase in the first half of the year. 23/ Although the planned increase in production was not achieved during the first half of 1955, there was an increase of 22 percent above the level of the first half of 1954. 24/ This is the same rate at which production during all of 1955 was planned to increase above the level of 1954. 25/ During the second half of 1955, planned increases in production were expected to be achieved by newly commissioned cement plants. 26/ The plan for commissioning new plants was not fulfilled, 27/ and production for 1955 increased only 18 percent above the level of 1954 (see Table 2**).

* In 1957 the per capita production of cement in the USSR was 142 kg 18/ and in the US, 310 kg [redacted] 50X1

** Table 2 follows on p. 8.

*** Following p. 8.

Table 2

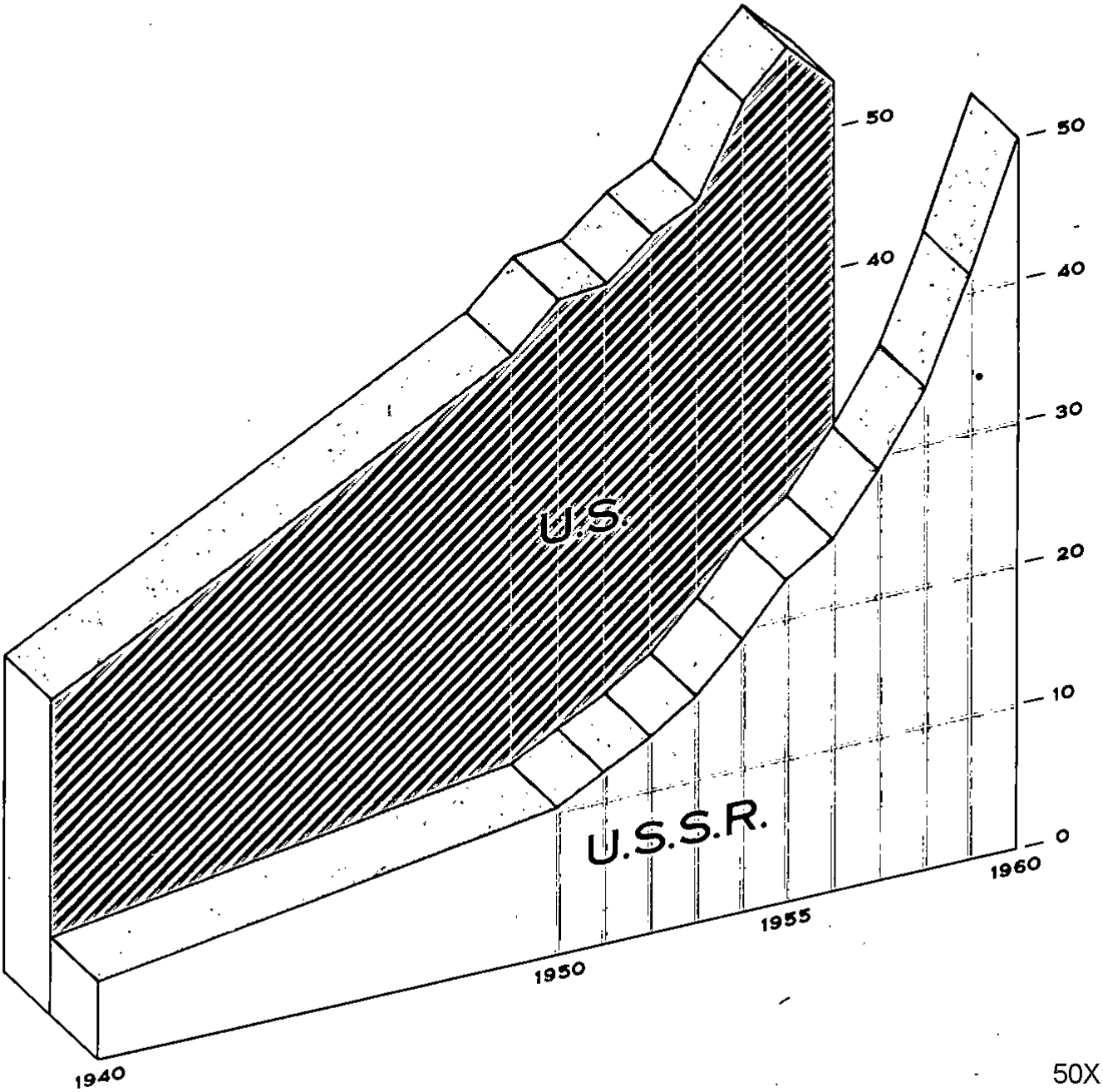
Production of Cement in the USSR, 1940 and 1950-60
and in the US, 1940 and 1950-57

	USSR			US		
		Change from Previous Year			Change from Previous Year	
Year	Production (Thousand Metric Tons)	Percent	Absolute (Thousand Metric Tons)	Production (Thousand Metric Tons)	Percent	Absolute (Thousand Metric Tons)
1940	5,675 a/			22,568 b/		
1950	10,194 a/	25	2,047	39,146 b/	8	2,951
1951	12,070 a/	18	1,876	42,410 c/	8	3,264
1952	13,910 a/	15	1,840	42,952 c/	1	542
1953	15,961 a/	15	2,051	45,504 c/	6	2,552
1954	18,992 a/	19	3,031	46,896 c/	3	1,392
1955	22,484 a/	18	3,492	53,535 c/	14	6,639
1956	24,861 d/	11	2,377	56,500 e/	6	2,965
1957	28,900 f/	16	4,039	53,100 e/	-6	-3,400
1958 (Plan)	33,900 f/	17	4,800			
1959	41,000 g/	21	7,300			
1960	50,000 g/	22	9,000			

a. 28/
b. 29/
c. 30/
d. 31/
e. 32/. Production of natural, slag, and hydraulic lime cement is estimated to have been 170,000 tons per year. Totals are rounded.
f. 33/
g. 34/. The original goal of 55 million tons for 1960 was revised downward to 52 million tons. To arrive at the goal of 52 million tons, an average annual increase of 21.6 percent would be required for the period 1958-60. Because the 1958 planned production of 33.9 million tons is only a 17.3-percent increase above the level of 1957, an increase of 23.9 percent for 1959 and 1960 would be required to achieve the 1960 goal. On the basis of the percentage increase planned for 1958 and past percentage increases, this rate of increase (23.9) is assumed to be too high, and the average annual rate required for the entire period 1958-60 (21.6 percent) is applied to 1959 and 1960 to arrive at an estimate of 41 million tons for 1959 and an estimate of 50 million tons for 1960. The maximum estimated range of underfulfillment is zero to 7 million tons.

Figure 2 50X1

PRODUCTION OF CEMENT IN THE USSR, 1940 AND 1950-60 AND IN THE US, 1940 AND 1950-57



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IV. Development, 1956-57.

A. Plan Underfulfillment in 1956.

In 1956 the cement industry of the USSR again failed to fulfill its assigned quota in spite of the modest increase planned. This poor showing is highlighted by comparison with 1955, as shown in Table 3. In spite of the smaller planned percentage increase in

Table 3

Plan Fulfillment and Increases in Production of Cement per Year in the USSR
1955-56

		Increases in Production Above Previous Year			
		Planned		Actual	
Year	Plan Fulfillment (Percent)	Percent	Amount (Million Metric Tons) a/	Percent b/	Amount (Million Metric Tons) a/
1955	97 c/	22 c/	4.2	18	3.5
1956	93	19 d/	4.3	11	2.4

a. Derived from the previous column and from Table 2 (p. 8, above).
b. See Table 2.
c. 35/. Revised plan.
d. Derived from Table 2 [redacted]

50X1

production, plan fulfillment in 1956 was lower than in 1955, and the percentage increase achieved was less. Production increased by only 2.4 million tons in 1956, although in 1955 it had increased by 3.5 million tons. The cement industry (along with a number of other important building materials industries) 37/ had performed even more poorly in the first half of the year, achieving only a 7-percent increase above the level of the first half of 1955.

In September 1956, Kaganovich, who at that time was a First Deputy Chairman of the Council of Ministers of the USSR, was again appointed Minister of the Construction Materials Industry, replacing P.A. Yudin, who had died in April 1956. This appointment was generally interpreted as a measure of the importance of the industry and of the

need to increase production.* 38/ Under the Ministry of the Construction Materials Industry the control apparatus for the cement industry which Kaganovich inherited again in 1956 apparently remained the same as in 1950. In June 1956, there were three main administrations for the cement industry directly subordinate to the Ministry, 39/ which in 1955 controlled 90 percent of the existing cement plants in the USSR.** The remaining plants were under the jurisdiction of other administrative organizations. The operating plants of the industry were thus subject to highly centralized control.*** In early October 1956, Kaganovich emphasized the primary role of the cement industry in fulfilling the construction program and spoke of the "urgent measures" adopted by the Party Central Committee and the Council of Ministers to insure the fulfillment of the 1956 Plan of the cement industry. 42/

In spite of these measures and the efforts of Kaganovich, the plan was fulfilled by only 95.3 percent by plants in the Western Regions and 88.9 percent by plants in the Eastern Regions for an over-all fulfillment of 93.1 percent. In addition to the underfulfillment, for the first time in a number of years the average quality of the cement was "considerably reduced."**** 43/ By the end of 1956, there were 75 operating plants in the USSR, or 1 more than in 1955, and the average annual output per plant (including new plants) had increased 9 percent, from 304,000 tons to 331,000 tons.† In 1956, nearly one-half of the operating plants of the cement industry of the USSR failed to fulfill their assigned quotas. At several plants the total output of cement in 1956 was lower than in 1955. Production lagged particularly in the Eastern Regions, where 14 out of 22 operating enterprises failed to fulfill the plan. 44/ As indicated in Appendix A,†† a minimum of 29 out of the 65 plants and combines listed failed to fulfill their 1956 quotas.

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* Kaganovich had been Minister of the Construction Materials Industry after World War II, which was a particularly critical period for the industry.

** See Appendix A, Table 20, footnote a, p. 61, below.

*** Under the Economic Reorganization Law promulgated in the spring of 1957, the Ministry of the Construction Materials Industry was abolished. 40/ By July 1957, nearly all the cement plants had been transferred to the subordination of the regional councils. At the beginning of 1958 there were cement plants in 45 of the 105 regions. 41/

**** A decline in the quality of cement suggests that the existing facilities were being strained to attain an increased quantity of production, for the quantity of cement produced may be increased if quality standards are lowered.

† See Table 7, p. 25, below.

†† See Appendix A, Table 19, p. 50, below.

One reason for plan underfulfillment in production of cement in 1956 was the defective operation of existing facilities. The rapid growth of the cement industry has resulted in a shortage of sufficiently trained and experienced personnel as well as a shortage of equipment. Causes for the failure to operate facilities fully were as follows:

1. Unsatisfactory quarry operations. At a number of plants the quarries were unable to provide sufficient limestone to operate the kilns at full capacity. 45/

2. Poor preparation of plants for winter operation. More than one-half of the plan underfulfillment in the first quarter of 1956 was caused by inadequate preparations for winter. 46/ The main element in the preparation for winter is a corollary of the above cause, in that a surplus of raw materials must be stockpiled for winter because of the difficulty in operating quarries at sub-freezing temperatures and with snow on the ground. Kaganovich had emphasized winter preparations in a speech in early October, 47/ and orders were issued that by 1 December 1956 the cement industry was to have stockpiled almost 1 million tons of limestone, chalk, and marl; about 300,000 tons of calcined gypsum; and more than 600,000 tons of granulated slag. 48/

3. Poor maintenance and repair of equipment. Kaganovich had stated that by the fourth quarter of 1956, repairs at plants were to be systematized and a stock of repair materials and spare parts was to be accumulated by each plant and was to be kept at a constant level. 49/

4. Inadequate supply of quarrying equipment and materials for repair and operational purposes at the plants. 50/

5. Shortages of coal. 51/

6. Low operating efficiency because of nonobservance of technical rules of operational efficiency 52/ and because of the low level of technical guidance at some plants. 53/

7. Slow introduction of automation and mechanization. 54/

Another, and the principal, reason for plan underfulfillment in production of cement in 1956 was the failure to complete new plants and capacities on schedule. It was planned that additions to capital investment in the cement industry in 1956 should more than double the level of 1955. 55/ The plan called for an increase in production of 4.3 million tons, but an increase of only 2.4 million tons was

achieved,* and production therefore fell 1.9 million tons short of the plan. The failure to complete new plants and capacities on schedule caused 1.1 million tons of this shortfall, 56/ or about 60 percent of the total shortfall. During 1956, facilities with a potential capacity of about 3.7 million tons of cement were not put into operation as planned, so that the plan for new capacity was implemented by only 30 percent. 57/ In addition, modernization of kilns lagged, especially in the Eastern Regions, where, in May 1956, only 5 of the 12 kilns which were to have been modernized by that time had been completed. 58/

The planned completion of new plants was even more seriously retarded. During 1956, 5 new plants were scheduled for completion, 59/ of which only 1 was operational during 1956 and 4 were not completed. A brief summary of conditions at the five plants follows:

1. Rustavi.

Commissioned (put into operation) in May 1956, 60/ this plant had the lowest plan fulfillment (59.5 percent) of any cement plant in the USSR.**

2. Novo-Zdolbunov.

This plant should have been commissioned in August 1955, 61/ but the first kiln did not begin operating until June 1956 62/ and the second kiln until September 1956, and the plant was not commissioned until March 1957. 63/

3. Irkutsk (Angarsk).

The construction plan of this plant was only 83 percent fulfilled in the first 5 months of 1956. 64/ A new completion date of December 1957 was set for the plant, with partial operation scheduled in October 1957. 65/

4. Yemanzhelinsk.

The two kilns in this plant began operating around the beginning of February 1957, and at the end of the month the grinding installations began operating. 66/ Construction of the plant started in 1948. 67/

* See Table 3, p. 9, above.
** See Appendix A, Table 19, p. 50, below.

5. Alekseyevsk.

This plant has been under construction for more than 5 years. Production was scheduled to begin in 1954, 68/ but the plant was not operational until 1957. 69/

The failure to increase capacity on schedule, especially in commissioning new plants, has been the chief deterrent to increasing production in the past and will continue to be the major problem in the future.

B. Plan Revision and Fulfillment, 1957.

At the end of December 1955 it was stated in Stroitel'naya gazeta that the output of cement in the USSR in 1957 was to be 1.6 times that of 1954, 70/ or approximately 30.4 million tons. This plan was subsequently lowered to 28.5 million tons. In June 1957, however, it was announced that the cement industry had overfulfilled the production plan by 365,000 tons during the first 5 months of the year, and the industry pledged a 600,000-ton overfulfillment for the year 71/ (29.1 million tons). The actual 1957 production was 28.9 million tons,* or 400,000 tons above the revised plan but about 1.5 million tons under the original plan. To attain the 1960 revised goal of 52 million tons, 72/ an average rate of increase of 18.3 percent is required in each of the 5 years 1956-60.** In the first 2 years an average annual rate of increase of only 13.4 percent was attained, however, necessitating an average rate of increase of 21.6 percent for the intervening years if the 1960 goal is to be achieved.

In 1957, 4 of 6 new cement plants which had been planned were put into operation. The plants commissioned were those which had been scheduled for operation in 1956 -- that is, Novo-Zdolbunov, Yemanzhelinsk, Alekseyevsk, and Irkutsk (Angarsk).*** 75/ The remaining 2 plants which were not commissioned (Kuybyshev and Semipalatinsk) 76/ are scheduled to be completed in 1958 along with a plant at Chimkent. In addition to the new plants completed in 1957, 7 new lines (kilns and auxiliary equipment) were added during the year. 77/ Total commissions in 1957 amounted to 3.6 million tons of capacity. 78/

* See Table 2, p. 8, above.

** During the Fifth Five Year Plan, production increased at an average annual rate of 17.1 percent. See Table 2.

*** The first 3 plants were operative in the first quarter of 1957 and the last plant at the end of the fourth quarter. 73/ A total production of more than 2.5 million tons is expected from these plants in 1958. 74/

During 1950-57, 20 new cement plants were activated, 73 new rotating kilns were completed (at the new and existing plants), and at the existing plants 82 rotating kilns and 22 automatic shaft kilns were reconstructed. 79/

V. Planned Development, 1958-60.

The planned production of cement in the USSR in 1960 was lowered in the revised plan from 55 million tons to 52 million tons, which is an increase of 131 percent above the level of production in 1955. 80/ The necessary average annual rate of increase to achieve the revised 1960 Plan for production of cement would be 18.3 percent,* which is one of the highest rates of increase planned for the production of a major industrial commodity.

If the 1958 goal of 33.9 million tons is reached, the average annual rate of increase for 1956-58 will be 14.7 percent, and the average annual rate required for 1959-60 will be 23.9 percent.** The attainment of this very high average annual rate of increase (and of the 1960 goal) is doubtful on the basis of the following factors:

1. Previous Production Failures.

As shown in Table 3,*** the cement industry failed to attain the assigned goals in 1955, and there was an even greater failure in 1956. In 1957, overfulfillment was possible only because of substantial lowering of the plan.****

2. Primary Dependence on New Plants.

According to the original Plan for 1960, 32 percent of the increase in cement output in 1960 was to be obtained from greater efficiency in the use of existing facilities and from the expansion and reconstruction of existing plants. The remaining 68 percent of the increase in production was to be obtained from newly constructed plants. 81/ During 1956-60, 27 new plants were to be completed, 17 of them in the Eastern Regions, where 4 plants were to be built in Kazakh SSR, 1 in Turkmen SSR, and 12 in the RSFSR. In the Western Regions, 7 plants were to be built in the RSFSR and 1 each in the Georgian SSR, the Ukrainian SSR, and the Moldavian SSR. 82/

* Derived from Table 2, p. 8, above, and the 1960 Plan.
** Derived from Table 2.
*** P. 9, above.
**** See IV, B, p. 13, above.

The revised plan of 52 million tons of production of cement for 1960 is to be attained with the completion of 16 new plants.* 83/ The substantial decrease in the number of new plants to be completed by the end of 1960 probably caused the decrease in the 1960 Plan. In addition, it is probable that, to attain the 52-million-ton goal in 1960, the expansion and reconstruction of existing plants will be increased.** Although construction of new plants is still the most important means of increasing capacity, the new plan for 1959-65 envisages a decrease in the dependence on new plants relative to the other means of increasing capacity. Under this plan, 12.2 percent of the increase will be derived from modernization of existing equipment and intensification of technological processes, 28.9 percent from expansions of existing plants, and 58.9 percent from new plants. 84/

It was announced in January 1956 that, in order to fulfill the 1960 Plan for cement, construction of new plants should require no more than 2.5 to 3 years, although, in the past, construction has frequently required from 6 to 8 years. 85/ In spite of the requirement to accelerate construction of cement plants, only 1 of the 5 scheduled for completion in 1956 began operating during the year,*** and in 1957 only 4 of 6 scheduled for completion during the year began operating.**** Thus the principal means for increasing capacity and production appears to be causing the greatest amount of difficulty.

3. Shortage of Equipment.

An enormous quantity of equipment will be required for the expansion envisaged for the cement industry by 1960. In the past a considerable amount of the equipment has been imported, largely from East Germany. In 1954 the USSR received equipment valued at 72 million rubles, or 75 percent of East German exports of cement plant equipment during that year. 87/ In 1955, East Germany agreed to export 5 cement plants† to the USSR 88/ and tentatively planned to export the same number in 1956. 89/ In 1957 it was planned to

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* The locations of the 11 plants which have been dropped from the original 1956-60 Plan are unknown.

** The cost (per ton of capacity) is generally greater in constructing new plants than in adding to existing plants.

*** See IV, A, p. 9, above.

**** See IV, B, p. 13, above. In 1958, 3 plants are planned to begin operation, and construction is to commence on 2 new plants (Noviy Spartak and Angren). 86/

† This term refers to equipment, probably not the complete equipment necessary for a cement plant.

export more than 100,000 tons of equipment valued at nearly 290 million rubles 90/; and in May 1957, East Germany agreed to export a total of 12 plants to be delivered in 1959 and 1960, with a total annual capacity estimated to be nearly 10 million tons. 91/ In September 1957, East Germany agreed to deliver during the next few years 23 cement plants with a total annual capacity estimated to be 18 million tons. 92/

The USSR is not presently capable of producing all of the equipment required for cement plants but plans to be self-sufficient by 1961. 93/ The magnitude of the East German exports indicates that the USSR is almost wholly dependent on that country to meet its plans for expansion. Because East Germany has not always been able to fulfill its commitments in the past, 94/ the USSR and Poland have agreed to supply some of the necessary raw materials and parts to compensate for the greatly increased Soviet requirements for equipment for cement plants in the future. 95/ Nevertheless, East Germany will probably continue to have difficulty in fulfilling Soviet requirements. This conclusion is supported by Soviet inquiries made to a number of West European firms during 1956 and 1957 concerning machinery for cement plants. 96/

VI. Planned Development After 1960.

Production plans for 3 years after 1960 have been announced for the cement industry of the USSR. It is planned to produce 60 million tons of cement in 1961, 97/ which is a 15.4-percent increase above the revised plan level for 1960.* It is probable, however, that the estimated underfulfillment of the 1960 Plan will be followed by a similar underfulfillment of the 1961 Plan. Preliminary data on the production plan for 1965 give figures ranging from 76 million tons to as high as 82 million tons. 98/ An average annual rate of increase of from 7.9 percent to 9.5 percent above the level of the revised production plan for 1960 is required to attain this goal.

A third plan was announced by Khrushchev in November 1957 as a preliminary estimate. 99/ He stated that production of cement in approximately 15 years (1972) would be between 90 million and 110 million tons annually. The midpoint (100 million tons) of these estimates of production for 1972 would be achieved with an annual increase of only about 3 to 4 percent above either of the planned levels of production for 1965 and can probably be easily achieved by that time. These statements indicate that if either 1965 goal is achieved the 1972 goal can be easily attained and the plan may possibly be increased.**

* See Table 2, footnote a, p. 8, above.

** At a cement workers' meeting in February 1958 it was stated that an annual production of 110 million tons of cement may be attained by 1970 and may increase to 150 million tons in 1975. 100/

VII. Inputs.

A. Materials.

The material inputs necessary to produce cement include raw materials, fuel, and power. The raw materials utilized are principally limestone, some clay and shale, and in some cases blast furnace slag.* In the US the total weight of these raw materials is approximately 170 percent of the weight of the output of cement,** 102/ but in the USSR (because of the greater use of slag) the total weight is assumed to be approximately 160 percent.*** Accordingly, it is estimated that about 46 million tons of raw material were necessary to produce 28.9 million tons of cement in the USSR in 1957.**** These materials are almost always quarried near the site of the cement plant,† and the quarries are normally part of the plant operation. Slag usually comes from a neighboring metallurgical installation.

The cement industry is one of the principal consumers of fuel in the USSR, and in a number of plants the consumption of fuel per ton of cement produced has been increasing. 105/ Coal is the principal fuel, but fuel oil and gas are also used, sometimes in combination with each other or with coal. It is planned, however, to increase the use of gas, and a number of large plants are being equipped to use gas. 106/ The consumption of standard fuel in the USSR is shown in Table 4.††

Electric power requirements for production of 1 ton of cement in 1951 were reported to be 85 kilowatt-hours (kwh).††† 107/ Total consumption of electric power in 1951 by the cement industry was therefore approximately 1 billion kwh.**** In 1957, production of

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* In cement made principally from limestone, 2 to 3 percent of gypsum is added in the final grinding process to regulate setting time and cement made with slag may have up to 5 percent of gypsum added. 101/

** Most of the loss of weight occurs in the kilns from evaporation and chemical changes.

*** In the US, slag accounts for about 1.5 percent of total raw materials, 103/ while in the USSR, approximately 16.5 percent is slag. (In 1951-55, about 32 percent of Soviet production was portland slag cement -- see Appendix A, Table 21, p. 62, below -- which includes approximately 50 percent raw ground slag. 104/)

**** See Table 2, p. 8, above.

† Gypsum and some other additives which account for a small percentage of the weight of the final product may be shipped in from elsewhere.

†† Table 4 follows on p. 18.

††† The estimated range of error is zero to plus 15 percent.

Table 4

Consumption of Standard Fuel a/
in the Cement Industry of the USSR
1950, 1955, and 1960

	1950	1955	1960
Consumption of standard fuel (kilograms) per metric ton of cement produced	229.0 b/	207.3 b/	193 c/
Production of cement (thousand metric tons) d/	10,194	22,484	50,000
Total consumption of standard fuel (thousand metric tons)	2,334	4,661	9,650

a. Standard fuel yields 7,000 calories per gram. Most of this fuel is coal, but the use of gas is becoming more significant.
b. 108/
c. 109/. Plan for plants having 3 production lines (kilns and the other necessary equipment to produce finished cement) and having annual capacities of 1.4 million tons in 1960. These are large plants, perhaps consuming somewhat less than the average amount of fuel per unit of output because of greater efficiency.
d. See Table 2, p. 8, above.

1 ton of cement was reported to require 100 kwh,* 110/ so that the total consumption by the cement industry in 1957 was approximately 2.9 billion kwh.**

Firebrick is another commodity which is indirectly consumed in cement production. The firebrick, with which the kilns are lined, wears off from the heat in the kiln and from the abrasive action of the clinker at the rate of 1.9 kg of brick per ton of clinker. According to the original 1960 Plan of 55 million tons, 75,000 tons of firebrick, at 340 rubles per ton, were expected to be consumed. 111/ Proportionally, for the 1957 production of approximately 28.9 million tons of cement,** 39,000 tons of firebrick costing about 13 million rubles were consumed. At the estimated 1960 production

* The estimated range of error is zero to plus 15 percent.
** Based on Table 2, p. 8, above.

of 50 million tons of cement,* 68,000 tons of firebrick costing about 23 million rubles will be consumed.

Consumption of fuel and electricity varies considerably between the individual plants. In 1955, 28.4 kwh of power were consumed per man-hour at plants producing more than 600,000 tons annually, while only 8.9 kwh were consumed per man-hour** at plants producing less than 100,000 tons annually (see Appendix A, Table 20***). 112/ Consumption even varies at plants of identical capacities. For example, in the second quarter of 1956 at two identical plants, both of which began operating at the same time, one consumed 26 percent more fuel per ton of clinker produced than did the other. 113/

B. Labor Force and Productivity.

During the Fifth Five Year Plan the goal for labor productivity in the cement industry of the USSR was probably fulfilled. This conclusion follows from the 5-percent overfulfillment of the 1954 goal in labor productivity 114/ by plants of the Ministry of the Construction Materials Industry and from the large increase achieved in labor productivity in 1955 above the level of 1954 (see Table 5****).

Because labor productivity varies directly with the size of the plant, it is planned to increase the average plant capacity during the Sixth Five Year Plan.† It was found in 1955 that for each 100,000 tons of cement produced at plants with a low capacity there were at least 600 workers; at plants with an average capacity, about 200 workers; and at plants with a high annual capacity (from 700,000 to 750,000 tons), 92 workers.†† 115/

By 1960 the planners hope to have plants which produce up to 2,500 tons per worker and hope to double the labor productivity for the entire country over that of 1955. 116/ Thus it may be inferred that they expect the average output per worker to be approximately 1,000 tons, so that, at the planned production for 1960 of 52 million tons,* the industry would employ 52,000 workers.††† In 1965, at the

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* Based on Table 2, p. 8, above.

** The larger plants are more highly mechanized.

*** P. 61, below.

**** Table 5 follows on p. 20.

† See Table 7, p. 25, below.

†† The larger plants are newer and more highly mechanized. See Appendix A, Table 20, p. 61, below, for average production per worker at plants of the various sizes.

††† In Western Europe, annual output per worker rose from 560 tons in 1950 to 704 tons in 1955 and /footnote continued on p. 20/

planned production of 76 million tons* and the planned output of 1,200 tons per worker, the industry would employ about 63,000 workers. 118/

Table 5

Labor Productivity and Estimated Labor Force at Cement Plants in the USSR a/ Prewar, 1950-55, and 1957

	Annual Production per Worker		Estimated Labor Force b/	
Year	Amount (Metric Tons)	Index (1950 = 100)	Workers	Index (1950 = 100)
Prewar	223 c/	82	25,300	68
1950	273 d/	100	37,300	100
1951	305 d/	112	39,600	106
1952	341 d/	125	40,800	109
1953	377 d/	138	42,300	113
1954	434 d/	159	43,800	117
1955	504 d/	185	44,600	120
1957	575 e/	211	50,300	135

a. With the possible exception of the prewar (probably 1940) and the 1957 figures, the annual production per worker is for plants which were directly controlled by the Ministry of the Construction Materials Industry. In 1955 this Ministry controlled 90 percent of the cement plants in the USSR.
b. The estimated labor force is derived from the first column and the total production of cement (see Table 2, p. 8, above). The estimated range of error for 1950-55 is zero to plus 8 percent. Plants which were outside the Ministry of the Construction Materials Industry were smaller than the average of Ministry plants.
c. 119/. Production of cement per worker in 1953 was 69.1 percent above the prewar level.
d. 120/. The estimated range of error is zero to plus 4 percent. Labor productivity was probably lower at plants which were not controlled by the Ministry of the Construction Materials Industry (see footnote a).
e. 121/

794 tons in 1956. In the US, annual output per worker rose from 1,513 tons in 1952 to 1,905 tons in 1955 and 2,033 tons in 1956. 117/

* See VI, p. 16, above.

The achievement of these plans for the increase of output per worker is possible, but an underfulfillment is more likely (especially in 1960) because of the magnitude of the planned increase and because of the relatively modest increase achieved by 1957 compared with these goals.

C. Costs.

The relative importance of the various inputs of the cement industry of the USSR is reflected in the costs of production. In 1955 the various costs of production in the cement industry accounted for the following percentages of total costs* 123/:

	Percent of Total
Raw materials	23.3
Fuel and power	38.4
Total wage payments	22.6
Amortization of plant and equipment**	9.3
Miscellaneous	6.4
Total	100.0

The categories of raw materials and total wage payments, which accounted for about 46 percent of the total costs in 1955, probably will decline proportionally because of increasing efficiencies in quarrying operations, the increased use of slag, and over-all increases in the productivity of labor. Amortization of plant and equipment, and to a lesser extent fuel and power, probably will increase as a percentage of the total.

The cost of amortization of plant and equipment or cost of capital investment in the cement industry is the highest in relation to total output cost of any industry in the USSR, [redacted] 125/ In addition, this cost per ton of clinker produced is increasing, as shown in Table 6.*** 50X1 50X1

* Percentages are derived by [redacted] the costs of production measured in 1 July 1955 rubles. [redacted] the cost of production of 1 ton of clinker averaged 94.54 rubles in 1955 and 95.88 rubles in 1956 (probably in 1 July 1955 prices). 122/ 50X1 50X1 50X1

** [redacted] for a long time the amortization period for new plants has been established at 25 years. 124/ 50X1

*** Table 6 follows on p. 22.

Table 6

Productive Capital Stock per Metric Ton of Clinker Produced in the USSR a/ Selected Years, 1940-56

Year	Current Rubles	Index (1950 = 100)
1940	134	54
1950	250	100
1955	286	114
1956	299	120

a. 126/

During the 8-year period 1950-57 the cost of production of cement decreased by 30 percent, and by 1965 the cost is expected to decrease by another 20 to 25 percent compared with 1957 (according to Soviet estimates). 127/ Thus in 1965 the cost of production of 1 ton of cement is planned to be almost halved compared with 1950. The attainment of this goal is probably possible if the use of slag as a raw material is considerably increased.

VIII. Capacity of the Industry.

A. Capacity and Production.

The capacity of any given cement plant is usually measured on the basis of the potential output of clinker from the kilns* plus the additives, all of which are ground into cement powder. The additives include approximately 2 to 5 percent of gypsum** (to regulate the setting time), varying amounts of ground slag, and other minor additives to give certain desired special qualities to the cement. The capacity of the industry is the total of the rated capacities of all the individual cement plants.

* The other processes carried out by the plant are generally planned to be sufficient to supply the kilns and process their output. These include quarrying, crushing, mixing, grinding, distribution, and storage.

** See VII, A, p. 17, above.

It is assumed that the Soviet cement industry utilizes a definition of annual capacity similar to that used by the Bureau of Mines in defining the capacity of the US cement industry. Annual capacity figures in the US are based on the producers' rated capacity (determined monthly), which is the production achieved over a period of continuous operation of the kilns with an allowance made for average annual "down time" caused by the necessity for normal periodic maintenance work. 128/

The failure of a plant to produce at its rated capacity may be caused by a decrease in the quality of raw materials, by inefficient operation, and by excessive down time for maintenance. A decrease in the quality of coal or other fuels may require the mix to be passed through the kiln more slowly than is possible with a better quality of fuel which permits a higher heat. The use of lower quality raw materials in the mix may also require increased roasting time in the kiln but is more likely to result in a lower quality of clinker. This in turn reduces the output of the plant* because it lowers the permissible amount of additive to the clinker in the final grinding process. 129/

There are numerous causes of inefficient operation of plants, including lack of skill of the operators, poor condition of equipment, and poor coordination of the several production functions. These shortcomings cause wide variations in output and efficiency among the various plants. An example is the case of two identical plants which began operating at the same time. At one plant the consumption of fuel was 20 percent lower, the output of clinker and the average grade of the cement were approximately 20 percent higher, and the cost of the clinker was 40 percent lower than at the other plant. 130/

A continuing cause of kiln down time is the need for partial replacement of the firebrick which lines the kiln because of the heat in the kiln and the abrasion of the clinker. The quality of the firebrick and the time required to replace the wornout firebrick in the kiln thus have a considerable effect on cement output and capacity. For example, in November 1953, at 17 plants which probably had the best production records in the USSR, the average period between necessary firebrick replacements in the kilns was 117 days. 131/ In 1956 the average life of a kiln lining, before the need for repairs, was from 100 to 105 days, 132/ and the average down time to repair the kiln was from 3 to 5 days. 133/ Thus the average loss of production time of the kilns during 1956 from this cause was from 11 to 17.4 days, or from 3 to 5 percent of the total possible kiln

* Assuming that the plant maintains its minimum quality standards.

operating time. Kiln relining is a costly process; one plant reported in September 1956 that relining one kiln cost the plant 150,000 rubles. 134/

B. Capacity in 1955, 1957, and 1960.

In 1955 the average capacity per cement plant in the USSR was 350,000 tons, 135/ and the average production per plant was 304,000 tons.* Thus the Soviet cement industry produced at approximately 87 percent of capacity.** Production totaled 22.5 million tons,*** so that capacity is computed to have been about 26 million tons.

By the end of 1960, capacity was planned to be 67 million tons.**** 136/ This increase in planned capacity would have been more than sufficient to achieve even the original production goal of 55 million tons in 1960, but it was also mentioned in conjunction with the revised goal of 52 million tons. 137/ Soviet planning appears to be rather confused concerning additions to capacity. In Stroitel'naya gazeta the planned additions to capacity for 1957 were stated in February 1957 to be 5.9 million tons, in June to be 7.2 million tons, and in August to be 6.9 million tons. 138/ Furthermore, Soviet figures for planned capacity appear to be higher than necessary to fulfill the accompanying production goals. For example, during 1950-56 the plan for the introduction of new capacity was not fulfilled in any year, 139/ yet the annual production plans were fulfilled for a number of the years. During this period the plan for the introduction of new capacity was fulfilled by only 52.8 percent. 140/

C. Growth, Costs, and Efficiency.

In the Soviet cement industry the number of plants has been increasing, but the average capacity† of the plants has been increasing at a faster rate, as indicated in Table 7.†† These increases in capacity (as measured by production increases in Table 7) have been accompanied by increases in kiln productivity which have resulted from increasing the output of existing kilns and from the installation of larger, more productive kilns. Kiln productivity and capacity have increased as indicated in Table 8.†††

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* See Table 7, p. 25, below.

** This figure is very close to the average annual utilization rate of rotary kilns in 1955 (see Table 8, p. 26, below).

*** See Table 2, p. 8, above.

**** [redacted] this figure is stated to be a 40-million-ton increase in capacity above the level of 1955. 50X1

† Measured by the average production.

†† Table 7 follows on p. 25.

††† Table 8 follows on p. 26. (Text continued on p. 27.)

Table 7

Production of Cement and Number of Cement Plants in the USSR
Selected Years, 1940-60

Year	Total Production (Thousand Metric Tons)	Average Production per Plant (Thousand Metric Tons)	Number of Plants	Index of the Average Production per Plant (1950 = 100)	Index of the Number of Plants (1950 = 100)
1940	5,675 a/	126 b/	45	77	73
1950	10,194 a/	164 b/	62	100	100
1955	22,484 a/	304	74 d/	185	119
1956	24,861 a/	331	75 d/	202	121
1957	28,900 a/	366	79 c/	223	127
1958 Plan	33,900 a/	413	82 d/	252	132
1960 Plan	52,000 e/	578	90 f/	352	145

a. See Table 2, p. 8, above.
b. 141/
c. 142/. The figure for 1957 is given.
d. 143/. See IV, A, p. 9, above and IV, B, p. 13, above.
e. Revised plan. (The original goal was 55 million tons.) See Table 2, footnote i, p. 8, above.
f. 144/. Planned new plants (16) added to the number of plants in 1955. The original plan called for the addition of 27 new plants for a total of 102 plants by the end of 1960. 145/

Table 8

Capacity and Production of Clinker in Rotary Cement Kilns in the USSR a/
1940 and 1950-55

Year	Average Annual Capacity per Kiln b/		Average Annual Utilization Rate per Kiln		Average Annual Clinker Production per Kiln	
	Amount (Thousand Metric Tons)	Index (1950 = 100)	Percent	Index (1950 = 100)	Amount (Thousand Metric Tons)	Index (1950 = 100)
1940	63.6	87	51	68	32.4	59
1950	73.4	100	75	100	55.0	100
1951	79.2	108	77	103	61.0	111
1952	83.2	113	79	105	65.7	119
1953	91.4	125	80	107	73.1	133
1954	97.9	133	82	109	80.3	146
1955	101.2	138	85	113	86.0 c/	156

a. 146/. For plants which were controlled by the Ministry of the Construction Materials Industry of the USSR. This included 90 percent of the cement plants in the USSR in 1955.
b. Capacity based on hourly production, assuming a 24-hour day and a 340-day year.
c. 147/. In 1955 the production cost of 1 ton of clinker averaged 94.54 rubles and in 1956, 95.88 rubles.

The cement industry has been increasing the production per kiln by installing larger kilns and has been gradually increasing the number of kilns per plant -- that is, building larger plants -- as indicated in Table 9.* These trends are expected to continue.

In 1955 the average annual capacity per plant was 350,000 tons, but in the next 15 years the cement industry hopes to build many of its plants with annual capacities of from 600,000 to 1.8 million tons. In certain areas where consumption is limited, small plants of 100,000 to 200,000 tons of annual capacity will be constructed. 148/ It was determined in 1955 that the higher the annual capacity of a new plant and its kilns, the lower were the required capital expenditures per ton of capacity. This is demonstrated in Table 10.** In 1957 it was ascertained that the cost per ton of cement was closely correlated with the capacity of the plant -- that is, the larger the plant, the lower the cost per ton. At the largest plants, 1 ton of cement cost 90 rubles, and at small plants, costs ran as high as 165 rubles per ton. 149/ By 1960, plants with kilns as large as 4.5 by 170 meters (m) will be constructed, for which capital expenditures per ton of cement output are expected to be even lower.*** 152/ The specifications of existing and planned large plants with 3 kilns measuring 4 by 150 m or 4.5 by 170 m**** are given in Table 11.†

Thus the cement industry hopes to increase considerably the average annual capacities of old plants and to build new plants of higher capacities incorporating larger kilns, which will increase considerably the total capacity of the cement industry at a decreasing cost per ton of output. In 1951-57, however, the actual costs frequently exceeded the planned costs. For example, in the RSFSR during 1951-57 the capital investment per ton of capacity at new cement plants averaged 402 rubles (including housing), when according to plan it should have been about 300 rubles. 154/ This suggests††

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* Table 9 follows on p. 28.

** Table 10 follows on p. 29.

*** A kiln of this size is a wet-process kiln. As of 1 January 1957, 92 percent of total production was by wet process. Two articles in Soviet periodicals have discussed the advantages of using dry-process kilns, which are shorter, less expensive, and consume less fuel per ton of clinker produced. 150/ It was stated that in the future, 28 percent of new plants should be dry process and 72 percent should be wet process. 151/

**** None of these kilns is believed to be in operation yet. [redacted] a kiln 5 m by 185 m with a daily production of 1,800 tons of clinker has been developed. 153/ 50X1 50X1

† Table 11 follows on p. 30.

†† Continued on p. 30.

Table 9

Relationship of the Estimated Number of Rotary Cement Kilns to Total Production and Number of Plants in the USSR Selected Years, 1949-65

	Kilns		Average Production of Cement per Kiln		
Year	Number	Index (1949 = 100)	Amount a/ (Thousand Metric Tons)	Index (1949 = 100)	Average Number of Kilns per Plant b/
1949	150 c/	100	54	100	2.5
1955	200 d/	133	112	207	2.7
1956	209 e/	139	119	220	2.8
1957	223 f/	149	130	241	2.8
1965	317 g/	211	240	444	N.A.

a. Production figures divided by number of kilns (see Table 7, p. 25, above, for 1949-57 production and VI, p. 16, above, for 1956 production).
b. Number of kilns divided by number of plants (see Table 7).
c. Derived from the number of kilns in 1957 (73 new rotary kilns were introduced at new and existing plants during 1950-57). 155/
d. Production of cement is computed to be 1.31 times production of clinker (with a range of error of plus or minus 5 percent). 156/ This figure was multiplied by the average production of clinker per kiln in 1955 (see Table 8, p. 26, above), and the product was divided into production of cement for 1955 (see Table 7, p. 25, above) to compute the number of kilns.
e. Nine new kilns were added in 1956. 157/
f. Seven new kilns were added at existing plants, and 7 kilns are estimated to have been added at the 4 new plants completed during the year (see IV, B, p. 13, above).
g. A total of 94 new kilns will be required during 1958-65 to obtain the necessary increase in production. 158/

Table 10

Capital Expenditures in Relation to the Capacities of Cement Plants and Kilns in the USSR a/
1955

Annual Plant Capacity (Thousand Metric Tons)	Capital Expenditures: Amount (Rubles per Ton)	Capital Expenditures: Index of Decrease of Rubles per Ton (First Row = 100)	Number of Kilns	Size of Kilns (Meters)
60	700	100	1	2.5 by 62
135	650	93	2	2.5 by 75
230	500	71	2	3 by 127
330	400	57	3	3 by 127
450	286	41	2	3.6 by 150
680	240	34	3	3.6 by 150
900	220	31	2	4 by 135

a. 159/. Cement plants include quarries.

the difficulty being encountered by the cement industry in lowering costs while at the same time expanding capacity.

Table 11

Specifications of Large Cement Plants in the USSR a/
1956 and 1960 Plan

Characteristics	1956	1960 Plan
Annual capacity (thousand metric tons)	660	1,400
Volume of buildings (cubic meters per metric ton of cement)	1.0	0.48
Investment (current rubles per metric ton of cement)	260	162
Standard fuel consumption b/ (kilograms per metric ton of cement)	230	193
Annual output of cement (metric tons per worker)	1,400	2,400
Cost of production (current rubles per metric ton of cement)	90	57

a. 160/. Plants having 3 kilns in 1956.
b. Standard fuel yields 7,000 calories per gram.

IX. Regional Distribution of Production and Consumption.

A. Factors in the Location of Cement Plants.

The cement industry is a raw-material-oriented industry because cement is a low-cost commodity in relation to bulk, and the weight of the raw materials in the Soviet cement industry is estimated to exceed the weight of the finished product (cement) by 60 percent.* The basic raw material, limestone, is computed in the US to account for five-sixths of the total weight of raw material inputs used in the manufacture of cement.** 161/ Limestone is abundant throughout most of the USSR, 162/ and economical plant operation requires a good quality of limestone which is easily

* See VII, A, p. 17, above. The weight loss occurs in the burning process in the kilns.
** A somewhat lower proportion of limestone is used in the USSR because of the greater use of slag (see VII, A, p. 17, above).

accessible, so that quarrying and transportation costs may be kept to a minimum.*

There are definite advantages to locating plants where large-scale production can be maintained because large plants can produce cement at lower cost as a result of lower fixed costs per unit of output and greater output per worker.** The scale of production should be limited, however, because the area of distribution of cement should be limited. This restriction is imposed primarily because cement is a semiperishable commodity which must be kept dry at all times and which may even deteriorate over a period of time from atmospheric moisture. Excessive transportation and storage time frequently results in deterioration in quality and may even render the cement useless.***

Thus the problems to be considered in the location of new cement-producing facilities include not only the optimum size of the plant near readily accessible limestone deposits of suitable composition (or slag) but also the location of present and future consuming areas.

B. Regional Distribution Through 1955.

Since 1946 the geographic distribution of production of cement (which had formerly been concentrated in only a few regions of the USSR) has been improved somewhat, but the construction of cement plants in the Eastern Regions has continued to lag. 163/ Nevertheless, during 1950-55, production of cement in the Eastern Regions increased by 139 percent compared with an increase of 121 percent for the whole country, but the deficit between production and consumption in the Eastern Regions increased from 910,000 tons in 1950 to 1 million tons in 1955. In Kazakhstan and Central Asia (Region X), the deficit increased from 420,000 tons in 1950 to 800,000 tons in 1955. This deficit as well as those of the other economic regions in the Eastern Regions was partially offset in 1955 by the large upsurge of production in the Urals (Region VIII), which raised production for that region from a deficit of 530,000 tons in 1950 to a surplus of 360,000 tons in 1955 by increasing production from less than 1 million to almost 3 million tons (see Table 12****).

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* Limestone quarries are almost always a part of the cement plant installation.

** See Tables 10, 11, and 20, on pp. 29, 30, and 61, respectively.

*** A considerable loss occurs in the USSR in the shipment of bulk cement by rail, which is the primary means of shipment (see IX, C, p. 33, below).

**** Table 12 follows on p. 32.

Table 12

Interrelationships Between Regional Production and Consumption of Cement in the USSR a/
1950 and 1954-56

Thousand Metric Tons

Economic Region		1950 Production	1950 Consumption b/	1950 Production in Relation to Consumption	1954 Production c/	1954 Consumption c/	1954 Production in Relation to Consumption	1955 Production	1955 Consumption b/	1955 Production in Relation to Consumption	1956 Production
Ia	Northwest	230 d/	630	-400	700	1,020 e/	-320	810 d/	1,130	-320	850 d/
Ib	North	Negligible d/	120	-120	60	200	-140	60 d/	210	-150	70 d/
IIa and IIb	West	650 f/	500	+150	1,060	960 e/	+100	1,230 f/	1,090	+140	1,250 f/
III	South	2,010 f/	2,380	-370	3,930	3,770	+160	4,620 f/	4,250	+370	4,960 f/
IV	North Caucasus (Southeast)	1,000 d/	800	+200	1,710	1,000	+710	1,960 d/	1,110	+850	1,970 d/
V	Transcaucasus	550 f/	870	-320	1,010	980	+30	1,120 f/	1,020	+100	1,560 f/
VI	Volga	930 d/	530	+400	1,540	1,760	-220	1,890 d/	2,360	-470	2,120 d/
VII	Central	2,210 d/	2,350	-140	3,930	4,040	-110	4,550 d/	4,680	-130	4,930 d/
VIII	Urals	920 d/	1,450	-530	2,360	2,130	+230	2,830 d/	2,470	+360	3,230 d/
IX	West Siberia	570 d/	560	+10	760	1,110	-350	1,190 d/	1,430	-240	1,360 d/
Xa and Xb	Kazakhstan and Central Asia	400 f/	820	-420	850	1,210	-360	920 f/	1,720	-800	1,120 f/
XI	East Siberia	250 d/	340	-90	510	680	-170	650 d/	880	-230	720 d/
XII	Far East	480 d/	360	+120	570	680	-110	670 d/	760	-90	730 d/
	Total USSR g/	10,190 f/	11,700 h/	-1,510	18,990 f/	19,520 i/	-530	22,480 f/	23,110	-630	24,860 j/
VIII-XII	Eastern Regions	2,620	3,530	-910	5,050	5,810	-760	6,260	7,260	-1.000	7,160

a. All data are significant to the nearest 10,000 tons.
b. 164/. Given in percentages.
c. 165/. Given in percentages.
d. 166/
e. Karel'skaya ASSR is included in Region II rather than Region Ia.
f. Aggregated from figures for union republics. 167/
g. Totals are derived independently from unrounded data and may not agree with the sums of their rounded components.
h. Estimated on the basis of estimated net imports in 1950. See X, p. 37, below.
i. Consumption is estimated to have exceeded production by the same percentage (2.8 percent) as in 1955. 168/
j. 169/

From 1954 to 1955 in the Eastern Regions the deficit in production increased from 760,000 tons to 1 million tons (see Table 12). By 1955 the Eastern Regions consumed 31.4 percent of all available cement in the USSR and produced only 27.8 percent compared with 1950, when 30.2 percent of the total was consumed and 25.7 percent was produced (see Table 13* and the map, Figure 3**).

In the Western Regions the most notable changes during 1950-55 occurred in the Volga Region (Region VI), where a 400,000-ton production surplus in 1950 changed to a 470,000-ton deficit in 1955, and the South (Region III), which changed from a 370,000-ton deficit in production to a 370,000-ton surplus. Also during this period the surplus in production in the North Caucasus (Region IV) was increased from 200,000 tons to 850,000 tons, and in the Northwest (Region Ia) the deficit in production was slightly decreased from 400,000 tons in 1950 to 320,000 tons in 1955 (see Table 12***).

For the USSR as a whole, consumption exceeded production in 1950 by an amount estimated to be 1.5 million tons, in 1954 by an amount estimated to be 530,000 tons, and in 1955 by 630,000 tons (see Table 12). Stocks are believed to have remained relatively constant, so that these deficits must have been made up by net imports.

C. Problem of Transportation.

The average length of haul of cement in the USSR has decreased considerably over the last 15 years. In 1940, cement was hauled an average of 1,001 kilometers (km); in 1950, 803 km; in 1954, 665 km; and in 1955, 640 km. 170/ During the Fifth Five Year Plan (1951-55) the 20-percent decrease in the average length of haul resulted in a saving of approximately 115 million rubles. 171/ A continued decrease in the average length of haul, however, will be hindered by the planned increases in the average size of plants,**** as the larger plants tend to ship their production greater distances. For example, in 1955 at 52 plants which shipped less than 500,000 tons of cement, the average radius of shipment was 391 km; at 9 plants which shipped between 500,000 and 1 million tons, the average radius of shipment was 526 km; and at 4 combines, each shipping more than 1 million tons, the average radius of shipment was 849 km. This latter group accounted for 26 percent of all the cement produced. 172/

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* Table 13 follows on p. 34.
** Following p. 34.
*** P. 32, above.
**** See Table 7, p. 25, above.

Table 13

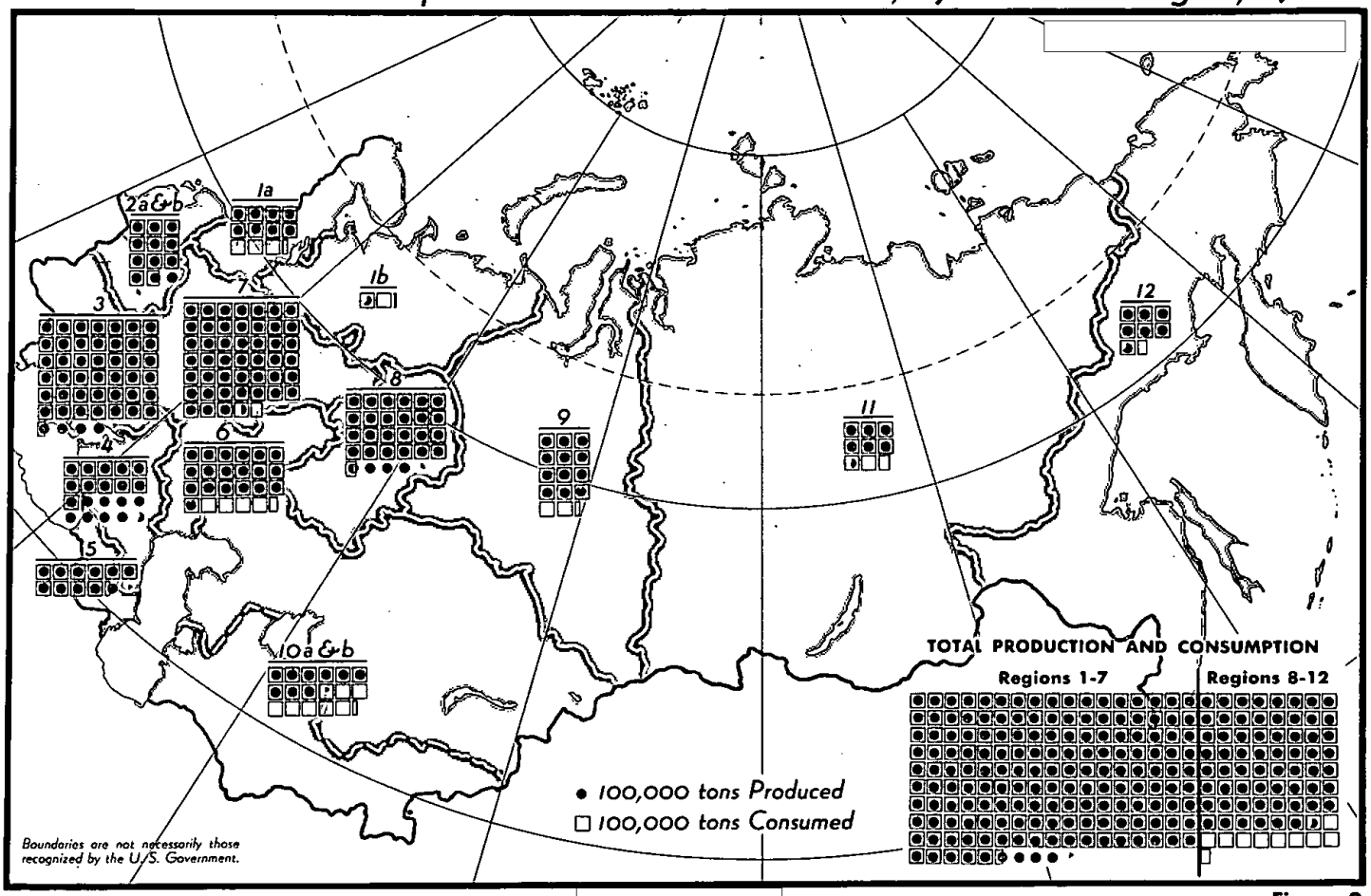
Regional Production and Consumption of Cement in the USSR
Selected Years, 1950-60

Percent of Total

Economic Region		1950		1954 a/		1955		1956	1960 (Plan)
		Production b/	Consumption c/	Production	Consumption	Production b/	Consumption c/	Production b/	Consumption c/d/
Ia	Northwest	2.3	5.4	3.7	5.2 e/	3.6	4.9	3.4	3.8
Ib	North	0	1.0	0.3	1.0	0.3	0.9	0.3	1.8
IIa and IIb	West	6.4	4.3	5.6	4.9 e/	5.5	4.7	5.0	3.1
III	South	19.7	20.3	20.7	19.3	20.6	18.4	20.0	15.1
IV	North Caucasus (Southeast)	9.8	6.8	9.0	5.1	8.7	4.8	7.9	4.3
V	Transcaucasus	5.4	7.4	5.3	5.0	5.0	4.4	6.3	3.9
VI	Volga	9.1	4.5	8.1	9.0	8.4	10.2	8.5	8.4
VII	Central	21.7	20.1	20.7	20.7	20.2	20.3	19.8	17.1
VIII	Urals	9.0	12.4	12.4	10.9	12.6	10.7	13.0	13.3
IX	West Siberia	5.6	4.8	4.0	5.7	5.3	6.2	5.5	8.7
Xa and Xb	Kazakhstan and Central Asia	3.9	7.0	4.5	6.2	4.1	7.4	4.5	10.2
XI	East Siberia	2.5	2.9	2.7	3.5	2.9	3.8	2.9	7.0
XII	Far East	4.7	3.1	3.0	3.5	3.0	3.3	2.9	3.3
	Total USSR f/	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
VIII-XII	Eastern Regions	25.7	30.2	26.6	29.8	27.8 f/	31.4	28.8	42.5

a. 173/
b. Percentages are derived from Table 12, p. 32, above.
c. 174/
d. This plan was formulated when the production plan for 1960 was 55 million tons. It is not known how the 3-million-ton reduction in the new plan for 1960 is to be allocated among the regions. Because of the large increases originally planned for the Eastern Regions, however, it is probable that the major portion of the cut will be in these regions.
e. Karel'skaya ASSR is included in Region II rather than Region Ia.
f. Totals are derived from unrounded data and may not agree with the sum of their rounded components.

Production and Consumption of Cement in the USSR, by Economic Region, 1955



25968 6-57

Figure 3 50X1

50X1

In 1956, 17.7 percent of the cement produced in the USSR was still being shipped more than 1,000 km.* These long hauls consumed 57 percent of the total transportation facilities used by the cement industry. Nine of the 13 economic regions were considered to have unduly high average lengths of haul, as shown in the following tabulation 176/:

Economic Region		Average Length of Haul (Kilometers)
XI	East Siberia	1,228
X	Kazakhstan and Central Asia	1,047
Ib	North	905
XII	Far East	873
VI	Volga	762
Ia	Northwest	510
IX	West Siberia	503
VII	Central	485
VIII	Urals	478

A major problem in decreasing the average length of haul is crosshauling. For example, in 1955 the Urals Region sent out more than 700,000 tons of cement and received approximately 400,000 tons, and Kazakhstan sent out up to 40 percent of the cement produced and received more than 70,000 tons from other regions of the country. 177/ Crosshauling is caused by an incorrect geographical distribution of production of the various types and grades of cement, 178/ poor coordination and planning, and faulty estimation of requirements. Poor distribution of production of the various types of cement alone increases transportation costs by about 50 million rubles per year. 179/ For instance, in the first half of 1954 the Ministry of Transportation (Railroads) reported that shortages of the various types and grades of cement in the different regions resulted in a 45-km increase in the average length of haul. 180/ The administrative reorganization, however, should facilitate a decrease in crosshauling.**

The railroads bear about 80 percent of the burden of shipping cement in the USSR, in spite of attempts to increase the proportion carried by water transport.*** 182/ Aside from the burden on the railroads, excessive shipment, particularly of bulk cement, results

* [redacted] the construction of small plants in regions more than 1,000 km from a cement plant was economically justifiable. 175/ 50X1

** See V, p. 14, above.

*** Although most of the water transport of cement is on rivers, some shipments are made by sea from the Black Sea area to the Far East. 181/

in considerable losses because of poor handling, storage, and shipping practices. In 1955, 80.4 percent of the cement was shipped in bulk and 19.6 percent in bags, and in 1956, 84.4 percent was shipped in bulk and 15.6 percent in bags.* In bulk shipment, 16 to 18 percent of the cement reportedly is lost (including construction site losses). [redacted] in 1960, 8 million to 9 million tons of cement will be lost, valued at 1 billion rubles. 183/ This very high loss ratio indicates that little cement is shipped in sealed hopper cars. Substantial improvement will be impossible without the almost exclusive use of these cars for bulk shipments. 50X1

D. Regional Distribution, 1956-60.

According to the original Sixth Five Year Plan (1956-60), consumption of cement in the Eastern Regions of the USSR was to increase from 31.4 percent of the total in 1955 to 42.5 percent in 1960. Four of the five Eastern Regions were to increase their share of the total, with only the Far East remaining constant through 1960. The only other region which was to increase its share of the total consumption by 1960 was the North (Region Ib), which was to go from 0.9 percent in 1955 to 1.8 percent in 1960.**

To increase regional self-sufficiency, the original Sixth Five Year Plan called for the construction of 17 new plants*** in the Eastern Regions out of a total of 27 for the whole USSR. 187/ Although complete regional self-sufficiency was not expected by 1960, a much greater degree was to be attained than there was in 1955. For example, in 1955, Region X (Kazakhstan and Central Asia) consumed 7.4 percent and produced 4.1 percent of total production of cement in the USSR, but in 1960 the region was to consume 10.2 percent** and to produce 9.8 percent of the total.****

* In the US, masonry cement is shipped in bags, and nearly all of the other cements are shipped in bulk. Bulk shipment is cheaper and easier to handle, but handling equipment is necessary and the cement must be stored more carefully.

** See Table 13, p. 34, above.

*** One of these plants was to obtain the raw materials as a by-product of a relatively new process by which alumina will be extracted from nepheline cyenite. The process yields a considerable slag, which is a semiprocessed material for the production of cement. 184/ In October 1956, plans were completed for the construction of the Achinsk Cement Plant in Krasnoyarskiy Kray in East Siberia. This plant is to have several kilns, each with a capacity of 60 tons an hour, and is to adjoin the alumina plant, 185/ which originally was scheduled to be completed by 1959. 186/ The cement plant will probably be capable of producing a large amount of cement shortly after the completion of the alumina plant.

**** Derived from Appendix A, Table 22, p. 63, below. Region X includes Uzbek, Kazakh, Tadzhik, Turkmen, and Kirgiz SSR's.

The revised plan for construction of new plants stipulates that 16 new cement plants will be constructed, mainly in the Eastern Regions, 188/ so that the new plan for the whole country calls for 1 plant less than was originally scheduled to be constructed in the Eastern Regions alone.* In addition, 4 of the 8 plants already completed or to be completed by the end of 1958 have been in the Western Regions.** Thus there has been a minimum reduction of almost 30 percent in the original plan for the completion of the number of new plants in the Eastern Regions, so that the gap between production and consumption in those areas probably will still be considerable in 1960, although some improvement may be expected.

X. Pattern of Trade Since 1948.

A. Exports Within the Sino-Soviet Bloc.

Albania is the only Sino-Soviet Bloc country which appears to receive cement from the USSR on a continuing, although very limited, basis. In the last 2 months of 1953, 2 small shipments totaling 4,530 tons were noted. 189/ In 1954, 1 shipment of 2,838 tons was reported and in 1955, 3 shipments totaling 11,500 tons. 190/ In addition to these limited shipments, the USSR exports token relief shipments. In 1954, 1,000 tons of cement were sent to North Korea 191/; in 1955, 7,983 tons were sent to North Vietnam 192/; and in November 1956, 10,000 tons were sent as a gift to Hungary. 193/ In 1957, cement was exported to Mongolia and again to North Korea. 194/

B. Exports Outside the Sino-Soviet Bloc.

Soviet exports of cement outside the Sino-Soviet Bloc have generally been limited and have gone to underdeveloped countries, probably as a part of the economic penetration effort. Exports of cement to Southeast Asia and the Near East totaled 156,000 tons in 1955 and 164,000 tons in 1956. 195/ These figures are believed to include almost all of the cement exported to Free World countries, as Iceland is the only country outside these areas believed to be receiving a significant quantity of cement from the USSR.

The countries to which the USSR has been exporting cement are listed below, along with the years in which exports were believed to have been made and the quantities, when available.***

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* See V, p. 14, above.

** See IV, p. 9, above.

*** The USSR and the European Satellites have an agreement under which intra-Bloc price competition in cement exports is minimized. 196/

1. Afghanistan.

Small shipments of cement were made by the USSR in 1955 and 1956. 197/

2. Burma.

In 1954, 2,181 tons of cement were exported. 198/ In 1956 an uninformed Burmese trade mission contracted for the importation of a total of 128,000 tons from the Bloc, of which the USSR was to supply 48,000 tons. This is far in excess of Burmese needs. The arrival of the cement in Rangoon choked that port, and much of the cement was reportedly ruined. 199/ However, as late as January 1958 a shipment from the USSR of 8,675 tons was noted. 200/

3. Ceylon.

A trade agreement was planned under which Ceylon was to import Soviet cement in 1956. 201/

4. Egypt.

In 1956, 50,000 tons of cement were to be shipped, 202/ and some shipments were noted in that year. 203/ Shipments continued in 1957. 204/

5. Ethiopia.

In 1957 the USSR was to ship 4,700 tons of cement. 205/

6. French Somaliland. A shipment of 4,470 tons of cement was noted in 1957. 206/

7. Iceland.

Imports in 1953 totaled 3,797 tons of cement 207/; in 1954, 50,957 tons 208/; in 1955, 36,000 (estimated) tons 209/; and during 1956-59 the USSR planned to send 50,000 tons a year. 210/

8. India.

In 1956 the USSR reportedly agreed to supply 120,000 tons of cement to India,* 211/ and shipments of approximately 50,000 tons were noted in the latter half of 1957. 212/

* Probably little of the cement was shipped during 1956.

9. Indonesia.

In 1955, Indonesia planned to import 15,000 tons of cement from the USSR, 213/ and in 1956 a trade agreement was signed in which one of the commodities to be exported by the USSR was cement. 214/

10. Iran.

Soviet exports of cement to Iran during 1950-56 were as follows 215/:

Year*	Metric Tons
1950	24,016
1951	8,410
1952	2,937
1953	15,952
1954	24,897**
1955	N.A.
1956	10,000***

11. Lebanon.

In 1956, small shipments of cement were noted. 216/

12. Pakistan.

Shipments of cement were noted during December 1955. 217/

13. Saudi Arabia.

A shipment of 3,850 tons of cement was reported in August 1957. 218/

14. Turkey.

It is estimated that in 1953, 22,000 tons of cement were received from the USSR 219/ and in 1955, 62,000 tons. 220/ In 1956, imports from the USSR continued. 221/

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* The Iranian calendar year begins in the latter half of March.
** March through August.
*** March to mid-June.

15. Yemen.

This country imported 3,000 tons of cement from the USSR in 1956. 222/

Soviet exports of cement to underdeveloped countries will probably increase, but they are not expected to account for a significant percent of domestic production by 1960. During 1956-60 the USSR expects to increase the shipment of cement from Novorossiysk by 66 percent compared with 1955. 223/ Novorossiysk is a large cement-producing area and the port of departure for nearly all seaborne exports of cement.

C. Imports.

It is apparent that the USSR has been continuously importing significant quantities of cement from the European Satellites, at least since 1950 when imports reached nearly 1 million tons from 4 of these Satellites (see Table 14).

Table 14

Estimated Soviet Imports of Cement from Four European Satellites
1950-52

Metric Tons

Country	1950	1951	1952
East Germany	195,000 a/	140,000 a/	349,300 b/
Hungary c/	60,000	N.A.	N.A.
Poland d/	270,000	285,000	320,000
Rumania e/	421,700	340,000	N.A.
Total	946,700	765,000	669,300

a. 224/
b. 225/
c. 226/. Estimated on the basis of shipments during 1 month.
d. 227/. The 1952 figure is a planned amount.
e. 228/. Including cement shipped under trade agreements and reparations.

In 1956, almost all of a total of approximately 2 million tons imported into the USSR is estimated to have come from Communist China and 4 of the European Satellites (see Table 15).

In addition to these shipments, a large amount of cement was sent to the USSR by Bulgaria in 1950, and some was also sent in 1951. 229/ East German shipments to the USSR were noted in 1954 and 1956, 230/ and Rumanian shipments to the USSR were noted in 1954 and 1955 231/; so it is probable that exports from these countries to the USSR continued in the intervening years. Polish exports in 1953-55 have been substantial, totaling 403,400 tons in 1953, 151,500 in 1954, and 69,000 in 1955. 232/

Table 15

Total Imports of Cement into the USSR a/
1956

Exporting Country	Amount (Thousand Metric Tons)	Percent of Total
Communist China	780 b/	39
Rumania	500 b/	25
Poland	323 c/	16
Bulgaria	143 b/	7
East Germany, Hungary	174 d/	9
Yugoslavia	80 e/	4
Total	2,000 b/	100.0

a. All figures other than those for Poland and Bulgaria are approximate.
b. 233/
c. 234/
d. The balance of 174,000 tons may be divided between East Germany and Hungary. Imports from other countries are believed to be negligible.
e. 235/

Communist China has been the largest exporter of cement to the USSR, and exports have been increasing since 1954 (see Table 16*).

* Table 16 follows on p. 42.

The Free World countries from which the USSR receives relatively small quantities of cement include Finland (7,612 tons in 1954 and 11,668 tons in 1955) 236/; Yugoslavia (80,000 tons in 1955 and again in 1956, a minimum of 23,000 tons shipped during 5 months of 1957, 237/ and a planned amount of 100,000 tons in 1958); and possibly Portugal (an undisclosed amount in 1953). 238/

Table 16

Estimated Exports of Cement from Communist China to the USSR
1953-56

Thousand Metric Tons

Year	Total Exports a/	Estimated Exports to the USSR
1953	350	290 b/
1954	330	270 b/
1955	420	340 b/
1956	950	780 c/

a. 239/
b. In 1956, exports to the USSR comprised 82 percent of total exports. The same percentage of total exports was assumed for the other years.
c. 240/

The USSR is estimated to have consumed 1.5 million tons of cement in excess of domestic production in 1950, 530,000 tons in excess in 1954, and 630,000 tons in excess in 1955.* This amount is approximately equivalent to net imports because cement is a semi-perishable commodity which cannot be stored for long periods of time, so that inventories may be assumed to be relatively constant. In 1956, net imports were probably more than 1.5 million tons.

The USSR therefore has been a net importer of cement for some years, and there is no available evidence to indicate that this situation will change in the next several years. On the contrary, the high and probably unattainable rate of production and consumption which has been planned for the future suggests that the net importation of cement will increase. Almost all of the Soviet cement imports come from Poland, Rumania, East Germany, Communist China, and

* See Table 12, p. 32, above.

Bulgaria. There is no available evidence which suggests that imports from any of these countries will decrease,* and, because of supply deficits in the regions of the USSR contiguous to Communist China,** imports from that country will probably increase.

XI. Quality and Types of Cement.

The quality of cement is designated in the USSR by a "mark," or grade number. This number refers to the minimum compressive strength (measured in kilograms per square centimeter) of a standard compressed mixture of 1 part of the cement to 3 parts of sand (to which water is added) after this mixture has hardened under given constant conditions for 28 days.*** 242/ Thus a mark or grade of 400 for a batch of cement indicates that the compressive strength of a standard sample containing this cement was not less than 400 kg per square centimeter after 28 days. The quality (grade) of the cement produced is very important because the quantity of cement required to make concrete of a given strength varies with the quality used -- that is, the effectiveness of the cement varies with the quality. Table 17 indicates the relationship between the quality of the cement and the quantity required.

Table 17

Quantity of Cement Required for Production of Standard Concrete a/ in the USSR, by Grade
1955

Grade	Quantity (Kilograms per Cubic Meter)	Index (400 Grade = 100)
200	416	158
300	320	121
400	264	100
500	227	86

a. 243/. This is the most common grade of concrete (as of 1955), having a compressive strength of 150 kg per square centimeter under given constant conditions.

* With the exception of Poland. 241/
** See Table 12, p. 32, above.
*** Each grade also has minimum tensile strength standards.

Thus increasing the average grade of cement produced from 400 to 500 will increase the effectiveness of the cement by 14 percent. Conversely, lowering the average grade of cement produced from 400 to 300 will decrease its effectiveness by 21 percent. In the USSR the average grade of cement has increased as shown in Table 18.

Table 18

Average Grade and Effectiveness of Basic Types of Cement in Construction in the USSR
Selected Years, 1940-57

Year	Average Grade		Index of the Effectiveness of Cement in Construction (1950 = 100)	
	Excluding Masonry Cement	Including Masonry Cement	Excluding Masonry Cement	Including Masonry Cement
1940 a/	N.A.	322	N.A.	N.A.
1950 b/	356	353	100.0	100.0
1951 b/	382	382	104.9	105.4
1952 b/	385	385	105.4	106.0
1953 b/	391	391	106.5	107.1
1954 b/	390	390	106.3	107.0
1955 b/	393	382	107.0	105.5
1957 c/	N.A.	403	N.A.	N.A.

a. 244/
b. 245/. All figures (including index figures) are reported.
c. 246/. Probably including masonry cement, although no specifications are given.

The increase in the average quality of cement during the Fifth Five Year Plan (1951-55) increased the effectiveness for the end user by 7 percent.* The plan for increasing the quality of cement during the Fifth Five Year Plan was not fulfilled, however. An expected 13.5-percent increase 247/ materialized into only an 8.2-percent increase.**

* Excluding masonry cement.
** Including masonry cement. See Table 18.

In 1956, "for the first time in a number of years, the cement industry considerably reduced the average quality of cement." 248/ The seriousness of this situation for the construction program in the USSR is evident from the discussion above. In addition, it indicates the difficulties which the Soviet cement industry was having in 1956 in attempting to fulfill its quantity production goals. Cement plants can increase the quantity of cement produced by the simple expedient of lowering the quality. In 1957 the industry regained quality control.

Thus, in the production of cement, increasing the quantity of production may have the effect of lowering the quality, which would require the end users to consume a greater quantity of cement to perform the same tasks. A determination of the average quality of the cement produced is therefore an important factor in analyzing the sufficiency of production for the needs of the economy.

In the USSR the increasing use of precast and prestressed reinforced concrete imposes a need for more production of rapid-hardening cement* and the higher grades of cement. 249/ During the Sixth Five Year Plan (1956-60), production of precast concrete is to increase 5.8 times to 28 million cu m, and production of prestressed concrete is to increase almost 50 times, to 7 million cu m. 250/ Although these plans will probably not be fulfilled, the demand for higher grades and for rapid-hardening cement will increase considerably.**

High-grade cement is needed because of the required high quality of precast and particularly of prestressed concrete,*** both of which are used as substitutes for structural steel. The use of rapid-hardening cement permits a considerably higher output from any given precast or prestressed concrete plant because the forms may be stripped after a considerably shorter period of time (usually 24 hours) than would be possible if ordinary portland cement were used, as concrete containing rapid-hardening cement attains a higher degree of strength in a relatively short period of time than does concrete containing ordinary portland cement.

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* In the US the comparable type of cement is called high early strength cement.

** The production of rapid-hardening cement was planned to be 2 million tons in 1957. 251/

*** Prestressed concrete is similar to precast reinforced concrete except that the reinforcing steel is pretensioned until the concrete has hardened. It then has considerably higher strength than regular reinforced concrete.

Portland and portland slag, the basic types of cement, comprise most of the cement produced in the USSR. From 1950 to 1955 the former generally accounted for about 50 percent of the total amount of cement produced, and the latter accounted for 30 to 35 percent and appeared to be increasing slightly during the period.* The several qualities and special types** make cement a nonhomogeneous product and cause crosshauling.***

XII. Prices.

The prices of the various grades and types of cement produced by plants formerly controlled by the central and republic governments of the USSR have been approved by the Council of Ministers 252/ and are believed to be generally sufficient to cover the cost of manufacture. Since 1950 the price of grade 250 cement has decreased. The following index constructed from the 1 July 1955 price as a base illustrates this decrease.**** 253/

Time	Price Index (1 July 1955 = 100)
1 July 1950	138
1 January 1952	119
1 July 1955	100

The average wholesale price of cement in 1950 was 107 rubles per ton, and in 1955, 113 rubles; thus in 1950 the total value of production was 1.1 billion rubles and in 1955, 2.5 billion rubles.† The average price varies between 1950 and 1955 because of the change in the regional production pattern, the grade, and the proportion of the different types of cement produced.††

* See Appendix A, Table 21, p. 62, below.

** Rapid-hardening cement is the only type in which production is to be increased considerably. There are numerous other types of cement with special qualities, including sulfate-resisting, oil well, and air-entrained cement (see I, p. 2, above).

*** See IX, C, p. 33, above.

**** Producer prices in Moscow Oblast, probably delivered, as of each year.

† Price per ton multiplied by annual production from Table 2, p. 8, above. Ruble values are in 1 July 1955 prices, f.o.b. station of departure.

†† Cement is priced by type (see Appendix A, Table 21, p. 62, below) and by grade (approximately grade 350 in 1950 and grade 400 in 1955 -- see Table 18, p. 44, above) /footnote continued on p. 47/

In 1951-52 the military establishments reportedly paid from 65 to 70 rubles per ton for cement (no grade or type specified), which was 41 to 44 percent of the price paid by industrial consumers. 255/ In the first quarter of 1956, Turkey paid an average of $21.12 per ton c.i.f. for 1,486 tons of cement (of unknown grade or type) imported from the USSR. 256/ Both of these prices appear to be low and suggest that in the field of defense and foreign trade, prices are not determined on the basis of costs. The pricing of cement in foreign trade is believed to be determined by bargaining between the USSR and the potential importer and by competition of the USSR with Free World exporters.

The prices of cement sold at retail in the USSR are considerably higher than the other prices for cement. For example, during 1956 [redacted] 50X1
[redacted] the American Embassy had to pay as 50X1
high as 50 kopecks per kilogram for cement [redacted] 50X1
[redacted] In March 1957, grade 250 cement 50X1
was advertised for retail sale in Voroshilovgrad, in the Ukraine, at 300 rubles per ton. 257/ However, a relatively small percent of the cement produced in the USSR is sold at retail. The plan for the allocation of cement for the general market in 1958-60 is as follows 258/:

Year	Million Metric Tons
1958	2.7
1959	3.5
1960	5.0

for five different price zones. 254/ The distribution of production of cement by regions (see Table 13, p. 34, above) and the distribution by republics (see Appendix A, Table 22, p. 63, below) were used to determine as closely as possible the percent of the total which was produced in each of the five price zones. The percent for each zone was multiplied by the price of the average grade (weighted by type) for each year, and the results were totaled. To get the undelivered price, zone 1 prices were decreased by 16 rubles and prices in the other zones by 20 rubles each. These prices are therefore weighted by price zone and by type, and each should be a true average price for the average grade of cement produced in the USSR in 1950 and 1955. It was, however, necessary to assume that the national average grade was produced in each price zone and also that the national complex of types was produced in each zone.

Thus if the plan were fulfilled, the retail market would increase its share of the total cement planned to be produced from 8 to 9.6 percent.* It is doubtful, however, that the plan for the release of cement to the general market will be fulfilled.

* Total planned production is from Table 2, p. 8, above.

APPENDIX A

STATISTICAL TABLES

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR by Region and by Republic a/*
1956

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
Ia (Northwest)			854
RSFSR			854
Leningrad (Vorovsk)	103.5	+9.1 d/	269 e/
Pikalevo	97.2	-8.1 f/	281 e/
Volkhov g/	N.A.	N.A.	304 h/i/
Karel'skaya ASSR			0
Ib (North)			72
RSFSR			72
Arkhangel'sk j/	N.A.	N.A.	7 k/
Vorkuta l/	N.A.	N.A.	65 m/
IIa (Baltic)			709
Estonian SSR			107
Kunda (Punane-Kunda)	100.5	N.A.	107 n/
Latvian SSR			375
Riga	100.2	N.A.	149 i/
Saldus (Brotseni)	101.3	+2.9 o/	226 e/
Lithuanian SSR			227
Akmyane	103.2	+7.0 d/	227 e/n/p/

* Footnotes for Table 19 follow on p. 56.

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR by Region and by Republic a/
1956
(Continued)

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
IIb (Belorussia)			539
Belorussian SSR			539
Krichev	97.9	N.A.	255 i/
Volkovysk	101.9	+5.3 d/	284 e/
III (South)			4,961
Ukrainian SSR			4,961
Amvrosiyevka Combine (2 plants) g/	99.3	N.A.	2,300 r/
Dneprodzerzhinsk	104.4	N.A.	60 s/
Dnepropetrovsk (Petrovsk) t/	N.A.	N.A.	115 t/
Khar'kov	101.2	+2.1 o/	177 e/
Kiev	100.0	N.A.	300 u/
Kramatorsk	103.8	+16.6 d/	453 e/
Krivoy Rog	100.2	N.A.	322 u/
Nikolayevsk	103.8	+17.0 d/	464 e/
Stalino (Puteprovod)	102.4	+2.1 d/	90 e/
Yenakiyevo	97.0	-15.8 v/	511 e/
Zdolbunov	102.8	+4.6 d/	169 e/
Moldavian SSR			0

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR by Region and by Republic a/
1956
(Continued)

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
IV (Southeast)			1,968
RSFSR			1,968
Novorossiysk Combine (4 plants) w/	95.3	N.A.	1,968
V (Transcaucasus)			1,555
Armenian SSR			210
Ararat (Armyanskiy [Armenian])	90.7	N.A.	210 n/
Azerbaydzhan SSR			672
Karadag	105.4	+32.0 o/	624 e/
Kirovabad	66.3	N.A.	18 y/
Tauz	102.2	N.A.	30 y/
Georgian SSR			673
Kaspi (Gruzinskiy [Georgian], Stalin)	95.2	-22.0	436 e/
Rustavi	59.5	N.A.	237 i/z/
VI (Volga)			2,115
RSFSR			2,115
Sebryakovo	101.6	+12.1 o/	768 e/
Sengiley	97.8	N.A.	70 aa/
Vol'sk Combine (4 plants) bb/	96.7	N.A.	1,277 i/

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR by Region and by Republic a/
1956
(Continued)

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
VII (Central)			4,926
RSFSR			4,926
Belgorod	99.0	N.A.	700 cc/
Bryansk	96.4	-43.2 v/	1,157 e/
Podgornoye (Kommunar)	99.3	N.A.	500 dd/
Podol'sk	95.8	N.A.	550 dd/
Ryazan' (Spartak, Mikhaylov)	104.9	+11.5 d/	246 e/
Shchurovo	100.6	+2.3 o/	386 e/
Tula (Soyuzshlak)	100.9	N.A.	250 dd/
Voskresensk	102.6	+6.9 d/	272 e/
Voskresensk (Gigant)	105.1	+42.0 d/	865 e/
VIII (Urals)			3,229
RSFSR			3,229
Katav-Ivanovsk	88.0	N.A.	150 ee/
Magnitogorsk	97.5	-22.6 v/	881 e/
Nev'yansk	100.0	N.A.	400 ee/
Nizhniy Tagil	76.0	-100.0 ff/	317 e/
Nizhnyaya Salda	103.0	+2.5 o/	86 e/
Novo-Troitsk (Orsk)	63.8	N.A.	350 ee/
Pashiya	95.5	N.A.	170 ee/

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR by Region and by Republic a/
1956
(Continued)

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
Pashiya (Novo-Pashiya)	76.8	N.A.	248 ee/
Sterlitamak	86.7	N.A.	280 gg/
Sukhoy Log	102.0	+6.8 o/	347 e/
IX (West Siberia)			1,362
RSFSR			1,362
Iskitim (Chernorechensk)	89.2	N.A.	523 hh/
Kuznetsk (Stalinsk)	100.4	+2.0 o/	502 e/
Yashkin	97.0	N.A.	337 i/
Xa (Kazakhstan)			555
Kazakh SSR			555
Karaganda	72.1	N.A.	525 ii/
Sas-Tyube	88.0	N.A.	30 i/
Xb (Central Asia)			567
Kirgiz SSR			8
Kurmenti 1/	N.A.	N.A.	8 jj/

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic a/
1956
(Continued)

Location and Plant Name b/	Plan Fulfillment b/ (Percent)	Announced Production Above or Below Plan (Thousand Metric Tons)	Total Production c/ (Thousand Metric Tons)
			25
Tadzhik SSR			
Stalinabad	100.0	N.A.	25 n/
			63
Turkmen SSR			
Bezmein	105.1	+3.1 d/	63 e/n/p/
			471
Uzbek SSR			
Angren	100.6	N.A.	60 kk/
Begovat (Khilkovo)	88.1	N.A.	161 i/
Kuvasay	100.7	N.A.	250 ll/
			722
XI (East Siberia)			
			722
RSFSR			
Noril'sk mm/	N.A.	N.A.	50 nn/
Krasnoyarsk	100.0	N.A.	403 oo/
Timlyuy	71.8	N.A.	269 oo/
			727
XII (Far East)			
			727
RSFSR			
Poronaysk (Yuzhno-Sakhalinsk)	78.6	N.A.	45 pp/
Spassk	104.7	+23.8 d/	531 e/
Teploye Ozero	100.2	N.A.	151 i/
Total USSR			24,861

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic a/
1956
(Continued)

a. This list of 65 plants and 3 combines (containing a total of 10 plants) is believed to include all of the plants classified as cement producers by the Soviet government (see Table 7, p. 25, above). The output of these plants accounts for the total production of cement in the USSR in 1956. Although the regional press and radio refer to other cement plants, it is believed that these other plants are producing low-quality hydraulic binders (below grade 200 quality) which the central government does not classify as cement.

The year 1956 is used because it is the only year for which reliable data are available on the production of individual plants. The production of 40 plants (more than half of the total number of plants), which accounted for 14.8 million tons (approximately 60 percent of the total production), has been determined with a high degree of reliability. The production of these plants was determined on the basis of published figures on percentage fulfillment and tonnage fulfillment, or the production was taken to be the residual in a region or republic for which the production of the other plants had been determined by the former method.

50X1

d. 261/
e. Derived from the figures for this plant in the two preceding columns.
f. 262/
g. 263/. This plant produces portland cement of high quality for reinforced concrete parts and industrial building sites.
h. 264/. Cement is produced in conjunction with alumina. More than 300,000 tons of cement were produced in 1955.
i. The residual of production in the region.

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic
1956
(Continued)

j. 265/. There is some doubt whether this plant is producing cement of sufficient quality to be considered one of the group of plants treated in this report.
k. Estimated. Believed to be a very small plant.
l. 266/. Mentioned in a national plan fulfillment report.
m. Estimated to account for most of the production in the region.
n. This is the only cement plant in the republic.
o. 267/
p. The slight discrepancy between production in the republic and the calculation of plant production from the two preceding columns is believed to be a result of rounding.
q. 268/. Two plants are listed [redacted] -- Amvrosiyevka No. 1 and Novo-Amvrosiyevka. Although 4 plants were formerly listed at this location as being subordinate to the Ministry of the Construction Materials Industry of the USSR, it is believed that Plants 1, 2, and 3 have been administratively consolidated into one plant and that Plant 4 is the new plant which was constructed during the Fifth Five Year Plan. There were also 3 lesser plants under local administration which are believed to be producing cement of too poor quality to be considered in the national total or to have been combined into one of the 2 plants listed above. 269/ 50X1
r. About 250 railroad cars of cement were dispatched from this combine daily. Assuming 25 tons per car and 365 operating days per year yields a total annual shipment of 2.3 million tons, which is in the middle range of estimates for this figure. The upper range of the estimate is derived as follows: the combine produced nearly 10 percent of the total output of cement in the USSR in 1956 -- that is, nearly 2.5 million tons. The lower range of the estimate is derived as follows: by the end of the Sixth Five Year Plan (1960), output is planned to increase to 3 million tons per year, 270/ and this output is to be almost 1 million tons above that of 1956 271/ (more than 2 million tons).

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic
1956
(Continued)

s. During the first 10 months of 1956, this plant produced 2,225 tons of cement above the plan. 272/ Assuming that the yearly overfulfillment was the same amount, and using the percent of overfulfillment shown in the first column (104.4), the production would have been 53,000 tons. Assuming that the same rate of overfulfillment continued for the rest of the year, the production would have been 63,000 tons. The midpoint between these 2 estimates was rounded to the nearest 10,000 tons.

t. In early 1957 it was stated that the plant turned out from 100,000 to 115,000 tons of portland slag cement per year. 273/

u. [redacted] the Kiev and Krivoy Rog plants appeared to be about equal in size. The residual of 622,000 tons for the region was therefore divided between the 2 plants almost equally. 50X1

v. 274/

w. 275/. Four plants are listed [redacted] -- Oktyabr', Pervomayskiy, Pobeda Oktyabrya, and Proletariy. 50X1

x. This is the only combine or group of plants in the region.

y. The Tauz plant was mentioned as one of the two largest plants in the republic. 276/ With a residual of 48,000 tons of production in the republic and considering the low fulfillment of the plan at the Kirovabad plant, the production at the Tauz plant must have been at least in the vicinity of 30,000 tons.

z. The annual capacity of this plant is planned to be 616,000 tons of cement. 277/

aa. 278/. This plant expected to produce 3,000 tons of cement in about half a month in 1957. The total calculated on this basis was rounded.

bb. 279/. Four plants are listed [redacted] -- Bol'shevik, Kommunar, Komsomolets, and Krasnyy Oktyabr'. 50X1

cc. The output per 150-meter kiln in this plant in 1955 was 200,000 tons. 280/. There were to be four 150-meter kilns with a total minimum production of 800,000 tons a year. 281/ The fourth kiln was operative in July 1956. 282/ Thus 3 kilns operated all year producing 200,000 tons each, and the fourth kiln operated half the year.

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic
1956
(Continued)

dd. The output of 3 plants as well as a residual of 1.3 million tons remained to be accounted for in the region. Available information suggests that the Podgornoye plant had a slightly higher output than the Podol'sk plant and that the Tula plant produced approximately half the amount of each of the other two plants.

ee. The output of 5 plants as well as a residual of 1.318 million tons remained to be accounted for in the region. Available information in conjunction with the respective plan fulfillments (in the first column) resulted in these estimates of production at each of the five plants.

ff. 283/

gg. In 1956, output was to increase by 90,000 tons above 1955. 284/ In April 1956 it was stated that the capacity of the plant was to be increased by 35 to 40 percent in a relatively short time. 285/ This increase yields a projected output of from approximately 315,000 tons to 347,000 tons. The plan fulfillment for the year (see the first column) of 86.7 percent was applied to this range, yielding a range of approximately 260,000 tons to 300,000 tons. The midpoint of the range was chosen for the estimate of production.

hh. 286/. Total planned production was 586,000 tons. The plan fulfillment figure (in the first column) was applied to this figure.

ii. Output per 150-meter kiln in 1955 was 131,500 tons. 287/ Four kilns with the same output were assumed for 1956, and the resultant figure was rounded to the nearest 5,000 tons. The facilities of this plant are identical with those of the Sebryakovo plant, and both plants were completed at approximately the same time. 288/

jj. This is believed to be the only plant in the republic which is producing a high enough grade of cement to be considered in the national total.

kk. This plant was to install a new kiln which was planned to almost double the output of the plant. 289/ It was assumed to be a 62-meter kiln, which has a capacity of 60,000 tons per year (see Table 10, p. 29, above), and that installation was not complete by the end of 1956.

Table 19

Plan Fulfillment and Estimated Production of Cement Plants in the USSR
by Region and by Republic
1956
(Continued)

ll. This plant was to install a new 150-meter kiln which was planned to almost double the productive capacity of the plant. 290/ A kiln of this size has a capacity of 225,000 tons per year (see Table 10, p. 29, above). The kiln was probably not installed by the end of 1956.

mm. 291/

nn. This plant appeared to have one kiln. 292/ It was assumed to be a 62-meter kiln, which has a capacity of 60,000 tons per year (see Table 10, p. 29, above).

oo. Krasnoyarsk had 3 technological lines, 293/ and Timlyuy had 2 lines. 294/ Production was estimated on the basis of a 3-to-2 ratio applied to the remainder of production for the region (672,000 tons).

pp. In 1957, more than 46,000 tons of cement had been produced by November. 295/ Thus on an annual basis, production should have been about 56,000 tons. This figure was modified by the plan fulfillment figure (see the first column) to obtain the estimated production for 1956, and the figure was rounded to the nearest 5,000 tons.

Table 20

Labor and Electric Power Inputs of Cement Plants
in the Ministry of the Construction Materials Industry of the USSR
by Size of Plant a/
1955

Annual Production (Thousand Metric Tons)	Plants		Production (Percent of Total)	Number of Workers (Percent of Total)	Average Annual Production per Worker (Metric Tons)	Electric Power Consumption per Man-Hour b/ (Kilowatt-Hours)
	Number	Percent of Total				
100 or less	9	13.4	2.4	5.8	211	8.9
101 to 200	13	19.4	9.0	12.8	361	11.3
201 to 300	17	25.4	19.1	24.9	389	18.1
301 to 450	9	13.4	15.2	14.0	552	20.8
451 to 600	11	16.4	25.6	21.8	600	23.9
Above 600	8	12.0	28.7	20.7	709	28.4
For all plants	67	100.0	100.0	100.0	504	20.8

a. 296/. The Ministry controlled 90 percent of the cement plants in the USSR. There was a total of 74 cement plants in the country in 1955 (see Table 7, p. 25, above).
b. Used for motive power.

Table 21

Production of Cement in the USSR, by Type a/
1940 and 1950-55

Percent

Year	Portland	Portland Slag	Pozzuolana	All Other Types	Total
1940	56.1	26.4	8.7	8.8	100.0
1950	51.8	32.1	11.5	4.6	100.0
1951	50.1	33.6	13.1	3.2	100.0
1952	52.0	32.6	12.0	3.4	100.0
1953	55.0	30.1	11.9	3.0	100.0
1954	51.2	32.4	13.8	2.6	100.0
1955	44.0	34.6	13.4	8.0	100.0

a. 297/. See I, p. 2, above, for technical definitions of these types of cement.

Table 22

Distribution of Production of Cement in the USSR, by Republic
Selected Years, 1940-60

Percent

Republic	1940 a/	1950 a/	1955 a/	1956 b/	Original 1960 Plan
RSFSR	62.9	64.6	64.9	64.3	66.4 c/
Ukrainian SSR	21.5	19.7	20.5	20.0	14.3 c/
Belorussian SSR	3.5	3.4	2.4	2.2	1.8 c/
Uzbek SSR	4.7	3.5	2.1	1.9	2.6 c/
Kazakh SSR	0	0.2	1.6	2.2	5.8 c/
Georgian SSR	2.1	2.6	1.7	2.7	2.2 c/
Azerbaydzhan SSR	2.0	1.3	2.3	2.7	1.7 d/
Lithuanian SSR	0	0	0.9	0.9	1.1 c/
Latvian SSR	1.1	2.1	1.6	1.5	1.1 c/
Tadzhik SSR	0	0.2	0.1	0.1	0.6 c/
Armenian SSR	1.7	1.5	0.9	0.8	0.8 c/
Turkmen SSR	0	0.1	0.3	0.3	0.8 c/
Estonian SSR	0.6	0.9	0.5	0.4	0.4 c/
Karel'skaya ASSR	0	0	0	0	0.2 e/
Moldavian SSR	0	0	0	0	0.2 f/
Kirgiz SSR	0	0	0	Negligible	Negligible
Total g/	100.0	100.0	100.0	100.0	100.0

a. 298/. Given in metric tons.
b. 299/. Given in metric tons.
c. 300/. Planned production increase given by republic.
d. This percentage is the residual after all other percentages were determined.
e. 301/. This estimate is based on the statement that hearth (slag) cement is to be produced for the first time, making it possible to import less cement from other parts of the country.
f. 302/. This estimate is based on a plan to build a cement plant in Rybnitsa during the Sixth Five Year Plan (1956-60).
g. Totals are derived from unrounded data and may not agree with the sum of their rounded components.

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