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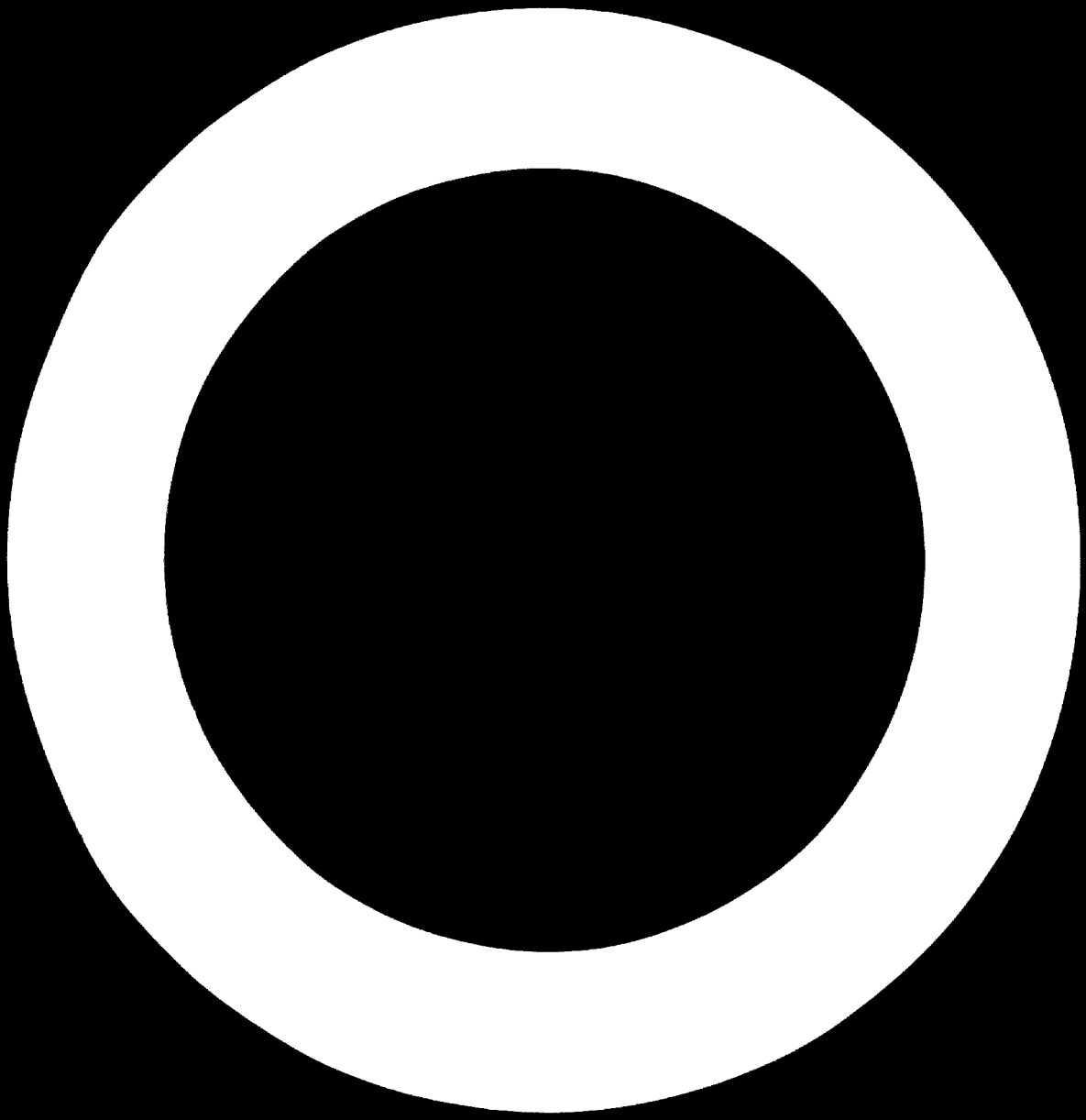

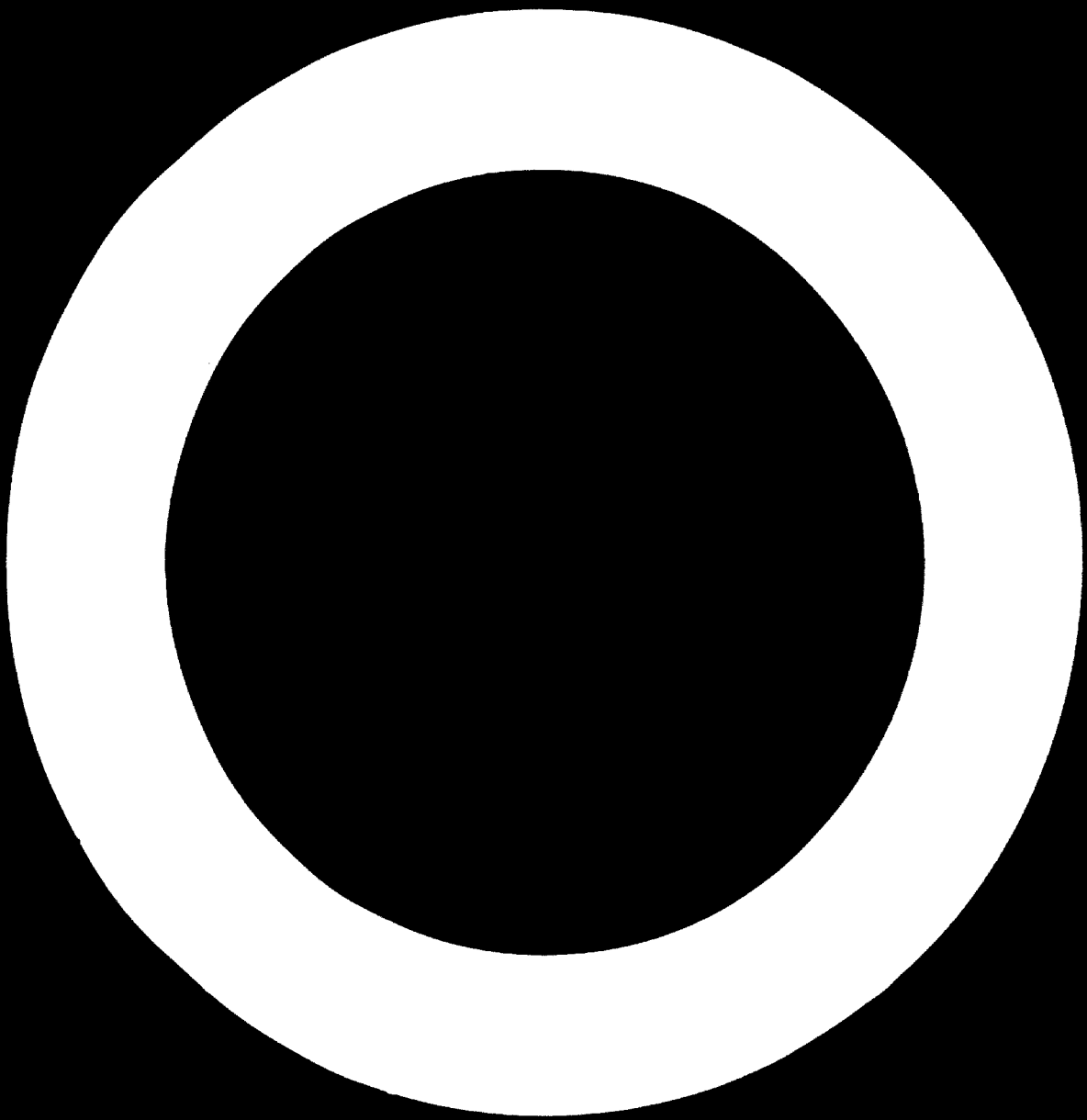

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

S. F. PROJECT - IRA-16

C/F COUNTRY: IRAN

pp 72

MASTER DEMAND STUDY FOR MECHANICAL & CAPITAL GOODS PRODUCTS 1972 - 1987

PART I

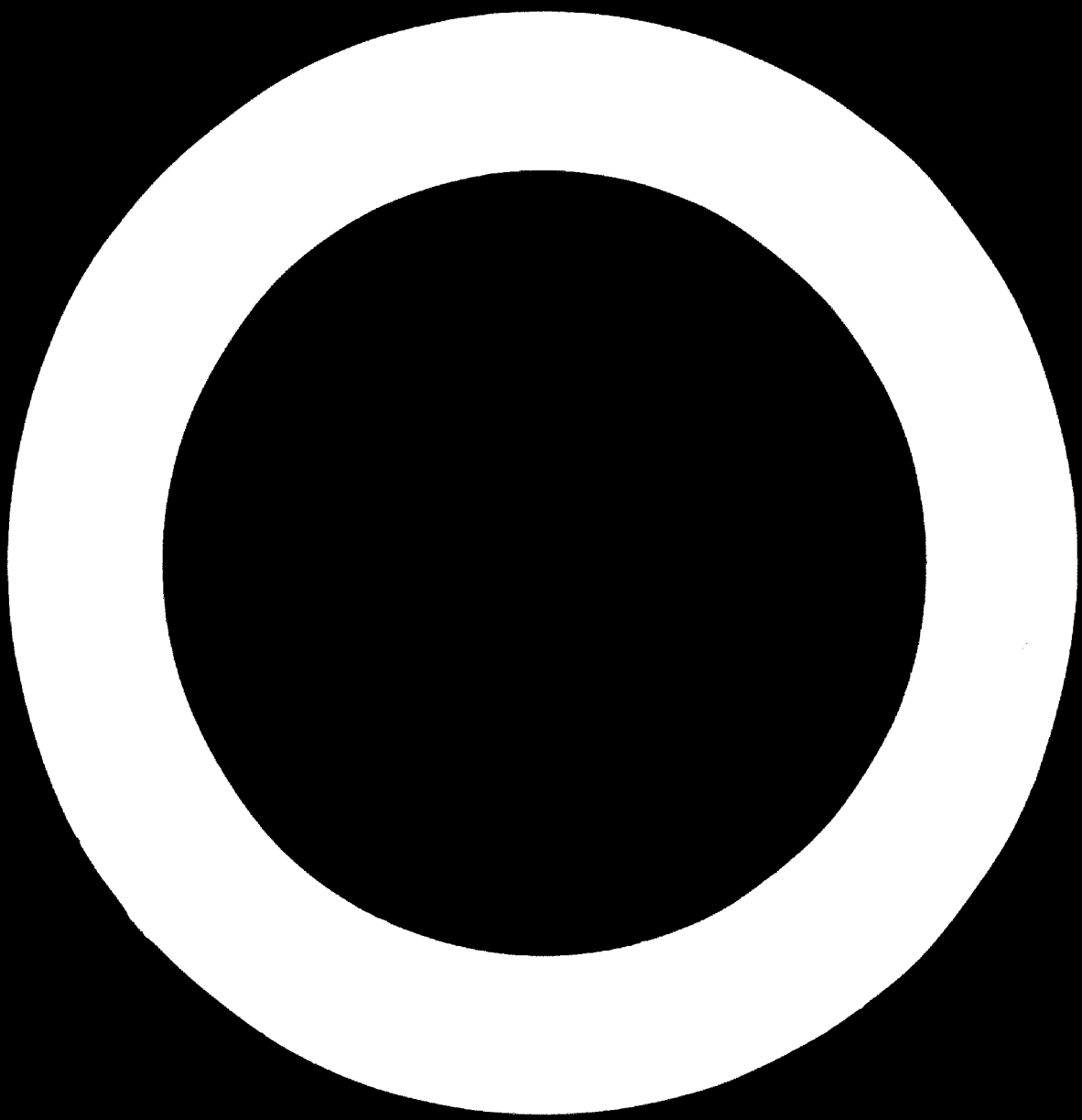
C/F

9. NON-METALLIC MINERAL PRODUCTS

Prepared by: Mr. Semsch

Counterpart: Dr. Ghaffarzadeh

Date: March 1973



Code No. 33 - Manufacture of Non-Metallic Mineral Products

Code No. 331 Manufacture of structural clay, products
Code No. 332 Manufacture of glass and glass products
Code No. 333 Manufacture of pottery, china and earthenware
Code No. 334 Manufacture of cement
Code No. 339 Manufacture of non-metallic mineral products.

According to the "Iranian Industrial Statistics 1968" published by the Bureau of Statistics of the Ministry of Economy, the Summary Statistics on Industrial Establishments in Iran in 1347 (1968/9) for Non-Metallic Industries were as follows

		Central Province	Isfahan and Yazd Province	Iran
Number of establishments		1630	459	4359
Persons engaged		16592	2619	36544
This: owners, employers and family members		1096	968	5241
salary and wage earners operatives		14532	1600	29653
others		964	51	1650
Fixed investment (before depreciation)	1000 Rials	1730290	95710	2019217
Value of gross output	1000 Rials	7100661	664682	10880133
Gross value added	1000 Rials	5400413	409842	7505138

Comparison of the Fourth & Fifth Five-Year Plan According to the "Fifth Five Year Plan"

		1346 (1967/8)	1351 (1972/3)	Growth Rate	1356 (1977/8)	Growth Rate
Number of persons engaged		52500	72200	38%	174000	141%
Cummulative investment	10^6Rls.	6600	20500	210%	88900	332%
Production	10^6Rls.	10300	20700	101%	65100	216%
Added Value	10^6Rls.	6800	13700	102%	42600	212%
Imports	10^6Rls.	1400	2900	107%	2900	-
Exports	10^6Rls.	-	400	-	1000	150%
Demand	10^6Rls.	11600	24100	108%	67000	178%

Code No. 331 - Manufacture of Structural Clay Products

Code No. 3311 Manufacture of bricks

Code No. 3312 Manufacture of baked pipes and roofing tiles

Code No. 3313 Manufacture of "Kashis" glazed tiles

Code No. 3314 Refractories products, heat resistant bricks and crucibles

Code No. 3315 Manufacture of sun-dried bricks

Code No. 3319 Miscellaneous manufacture of structural clay products including architectural terracotta

Code No. 3311 - Brick Factories

Bricks are made from clays, which are distributed very widely throughout Iran. (Until now there is no factory in Iran producing sand bricks).

According to the statistic data, there are approximately 2000 bricks factories in Iran at present, but only 336 of these factories are employing more than 10 workers and only 30 are mechanised, of these 17 are located in Teheran area.

Production of Bricks in Iranian cities according to the Bureau of Statistics of the Ministry of Economy was (in 1000 pcs)

	1344 (1965/6)	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)
Bricks in total	2,347,279	2,134,797	2,995,897	2,545,634
From these machine made	217,000	265,068	57,158(!)	n.g.

According to the Research Centre of the Ministry of Economy production of bricks in Iran (including villages) was:

		1346 (1967/8)	1347 (1968/9)
Production of bricks	1000 pcs.	4,250,000	4,394,000

As given above, only 10-12% of bricks are machine made, all others are hand moulded. The clay is dug down by hand, watered and trodden by feet. Afterwards soft plastic clay is thrown into moulds and the surface

shaped by hand tool. After being dried in the open air, bricks are fired in different kinds of kilns. The most primitive are field kilns (unfired bricks are arranged so that between each brick there is an open space for hot gases and the whole pile is covered by fired bricks and clay), the best are Hoffmann kilns.

Hand moulded bricks are of low quality. They have low bearing capacity in comparison with machine made bricks and very often they are underburned, causing blooming on the walls of houses etc. These bricks cannot be used for high buildings, and for this reason they will be replaced in future by machine made bricks; hand moulded bricks will be used in future only in villages for small houses, for fencing, etc.

The size of bricks moulded by hand and also those made by machine is 23 x 11 x 5, 5 cm, except hollow bricks, which are bigger.

Characteristic of Existing Machinery and Equipment:

In big factories clay is dug by various machines, mostly by shovel and bucket excavators. The transport from clay pit to stores and to brick factory is done by diesel locomotives and bogies, by dump cars or by lorries.

Clay is transported to feeder which is feeding uniform quantity to belt conveyors and to machinery and equipment. From different processes used abroad (wet process, semi-dry process, stiff plastic process, full plastic process) only the wet process is employed in Iran at present.

Clay is crushed by being passed between one or two pairs of cast iron rollers. In some factories there are used wet pans with edge runners. Crushed clay is transported to horizontal mixer, having one or two long shafts fitted with knives, where the clay is mixed with water and then shaped either in worm press or vacuum worm press. Cuttingoff is usually automatic. Bricks are taken off either manually or by machinery onto the pallets or laths, used for the transport of green bricks to drying plant. Drying is done mostly in chamber dryers and then transported to kiln for burning.

For burning mostly Hoffmann kilns with mechanical heating by coal powder or fuel oil are used; up till now there is not a single tunnel kiln installed in Iran. It is presupposed by the Ministry of Economy that during the two five-year Plans approximately 700 new brick factories will be installed (to some areas bricks are now transported over 300 km), from these approximately 500 units will be fully mechanized.

Forecast of Demand and Production of Bricks in Iran in 1000 pcs.

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand of bricks	5800000	9000000	13200000	17400000
Production of bricks	5800000	9000000	13200000	17400000
from this machine made bricks	500000	2000000	6000000	11000000

The above given forecast of demand of bricks has been made by the author of this study on the base of the following assumptions:

1 - Covered area of buildings in sq. m. given in Code No. 400 - Construction of Building.

2 - Consumption of bricks per sq. m. of covered area as follows:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
New Private and Public Construction of Housing and City Building:		0		
Kiln bricks and steel	210	200	186	174
Reinforced concrete	185	174	160	148
Kiln bricks and wood	190	185	180	175
Prefabricated elements	36	30	24	18
Other	165	156	150	144

Cont'd.

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
New Private Construction Industry and Trade				
Kiln bricks and steel	180	172	162	155
Reinforced concrete	165	158	150	144
Kiln bricks and wood	170	-	-	-
Prefabricated elements	40	34	28	23
Other	120	112	104	96
Public Construction Industry				
Kiln bricks and steel	115	103	90	76
Reinforced concrete	105	92	80	64
Kiln bricks and wood	94	-	-	-
Prefabricated elements	48	42	35	24
Other	70	64	56	50

For comparison, consumption of bricks pieces per capita in different countries is given (see below).

Consumption of bricks - Pieces per Capita in Different Countries:

	1955	1960	1965
U.S.A.	48	38	39
Great Britain	147	139	121
West Germany	118	117	99
France	94	89	95
Czechoslovakia	113	146	167
Soviet Union	106	132	171

Consumption of Bricks in Iran - Pieces per capita

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Consumption pieces per capita	186	249	308	356

Demand of Bricks - Calculation in 1000 pcs.

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)
New Private Construction & Public Construction of Housing and City Buildings:			
Kiln bricks and steel	3,463,110	5,353,400	7,103,570
Reinforced concrete	266,770	672,160	1,423,840
Kiln bricks and wood	429,780	379,430	555,480
Prefabricated elements	22,000	48,270	96,720
Other	325,570	397,180	490,350
Construction Industry and Trade:			
Kiln bricks and steel	339,120	599,220	935,550
Reinforced concrete	22,770	58,460	153,600
Kiln bricks and wood	15,980	-	-
Prefabricated elements	1,200	5,440	12,040
Other	11,280	13,100	21,740
Public Construction Industry			
Kiln bricks and steel	332,920	543,110	867,870
Reinforced concrete	20,660	72,310	150,640
Kiln bricks and wood	13,720	-	-
Prefabricated elements	3,070	13,440	30,960
Other	4,340	12,030	20,160
Sub-total	5,273,310	8,167,550	11,861,620
Other, such as repairs, agricultural buildings, fencing, bridges cable sheets etc. approximately 10 - 12% of sub-total	526,690	832,450	1,338,380
T o t a l	5,800,000	9,000,000	13,200,000

Code No. 3312 - Manufacture of Baked Pipes and Roofing Tiles

Roofing tiles are produced and used mostly in the Caspian Region. As the production of roofing tiles and baked pipes is in all cases part of brick factories, the machinery and equipment for this production is given in the Code No. 3311.

Code No. 3313 - Manufacture of "Kashie" Glazed Tiles

There are two kinds of glazed tiles, produced in Iran:

1. Wall Tiles Made of Earthenware:

There are 2 factories producing wall tiles made of earthenware on big scale:

Karkhaneh Tolidi Teheran - Iran Tile Factory:

Modern factory, having capacity of 9000 - 10000 sq. m. /day i.e. approximately 2, 500, 000 sq. m. /year, thickness 6 mm. The production in 1348 (1969/70) was 1, 010, 987 sq. m.

Karkhaneh Jate Kashie Saazi Teheran:

Modern factory, producing wall tiles; the production in 1348 (1969/70) was 413, 332 sq. m.

Description of Existing Machinery, Equipment and Process:

Raw materials (bentonite, caoline from Tabriz, clays from Mashad and Teheran) are crushed and transported to the bins, then they are weighed and milled with water in a drum mill. The liquid mass is sieved, demagnetized and poured to a propeller blunger from where it is pumped to a hot air counterflow atomizer (drier) where water is evaporated and the mass is transported by a belt conveyor to the silos. The mass is fed to the automatic friction presses where it is shaped to a form of wall tiles. After pressing the tiles, they are dried in a continuous drier and then dried and inspected products are loaded on the trucks of the biscuit firing tunnel kiln fired with crude oil. After firing tiles are glazed and fired again, then inspected and ground automatically on two spedial grinding machines, interconnected by a special conveyor.

Production of Wall Tiles According to the Bureau of Statistics of the Ministry of Economy

	1344 (1965/6)	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)
Production of Wall Tiles all types - sq. m.	428,789	1,198,430	1,782,000	1,779,000

In these figures both types of wall tiles are given, i.e. earthenware as well as terra-cotta. There is overproduction of wall tiles made of earthenware in last years and the installed capacity is not fully utilized. This was taken into account by the calculation of new machinery and equipment.

Forecast of Production of Wall Tiles Made of Earthenware:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production of Wall tiles 1000 sq. m.	2,270,000	4,560,000	7,400,000	11,600,000

Using 1347 (1968/9) as the base year and the historical annual rate of increase of production of wall tiles as well as growth rate of construction of building (see Code No. 400 - Construction of Building), figures for the years 1351 (1972/3) until 1366 (1987/8) were exterpolated, by the author of this study.

2. Terracotta Wall Tiles:

There are plenty of small workshops in Iran producing glazed terra-cotta wall tiles. These wall tiles are mostly decorated either by one colour and then cut to required shape to fit the mosaic or square wall tiles decorated by more colours with Persian ornamental design. These wall tiles are used for decoration of walls (and roffs) of mosques and houses built in Persian style. The machinery and equipment of these workshops are very primitive - hand operated or mechanical press and a simple furnace. There will be no substantial increase of the production in these workshops in next years.

Code No. 3314 - Refractory Products, Heat Resistant Bricks and Crucibles

Refractory materials are fire resistant materials used for lining a wide variety of furnaces, boilers, kilns, for heat insulation etc. in metal processing industry, cement, brick, glass and ceramic industry, in power plants, chemical industry, etc. Their desirable properties are refractoriness, resistance to corosive chemical reactions, resistance to deformation under loading at high temperature, resistance to temperature changes or to resistance to abrasion.

Refractory Materials are grouped into these categories:

1. Aluminosilicate refractory products or fire clay refractory products (chamotte) are made of refractory clays of which essential mineral components are hydrated aluminium silicates (min. 30% of Al_2O_3 after burning). There are different kinds of these products produced from acid up to high alumina content refractory products, (made of bauxite, kyanite, etc.). It is the most common refractory material used. In advanced countries this group represents approximately 50% of all refractory products, in Iran, at present the ratio is even higher - approximately 70%.

2. Siliceous refractory materials are made of crystalline quartzites. They are used primarily for roofs of kilns in metal processing and glass industry.

3. Magnesite refractory materials are made of the magnesia minerals. Different kinds of products are named according to the raw materials used for production - magnesite, dolomite, fosterite, olivine. Magnesite refractory products are mostly used in metal processing industry in furnaces with basic process, for ladles in steel foundries etc.

4. Chromite refractory materials are made of chromite or are a solid solution of chromic oxide with the oxides of aluminium (chrome magnesite refractory materials). These materials are used primarily for production of open hearth furnaces etc.

5. Carbon refractory materials are made of graphite mixed with fire clay and anthracite mixed with tar. These refractory materials are used for production of crucibles in metal processing industry, carbon refractory blocks are used for lining of hearth and lower part of blast furnaces, for lining furnaces for melting of aluminium, lead, antimony, ferrosilicium, etc.

6. Zirconium refractory materials are made of mineral baddeleyit (ZrO_2) or zircon ($ZrSiO_4$). They are very expensive and therefore are used for production of crucibles for melting siliceous glass, pure platinium etc.

7. Silicon carbide refractory materials (carborundum) are made of quartzite mixed with coke or anthracite. Silicon carbide is used as refractory material in ceramic industry (for production of saggars) and in glass industry. Silicon carbide is used also for grinding wheels (see production of Abrasives).

8. Oxide refractory materials made of chemically pure Al_2O_3, MgO, CaO, BeO, CeD_2, ZrO_2, ThO_2, UO_2 etc. These materials are used for furnaces and crucibles for the highest temperatures, for insulators, and moderators in nuclear reactors etc.

9. Nitride refractory materials and other special refractory materials.

There is only one plant producing the refractory material chamotte on small scale in Iran at present: Tile Manufacturers in Amin Abad. The productior is approximately 3000-4000 tons/year. All other refractory products are imported.

Import of Refractory Products in tons

Tariff Code No.	Product	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
177A2	Burnt, washed, ground fireclay	1190	578	1021	2864	4727
179	Graphite washed, ground	237	415	455	678	710
188	Ground magnesite	127	227	37	108	10

Import of Refractory Products in tons (Cont'd.)

Tariff Code No.	Products	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
650-1	Fire-proof bricks made of chamotte, dinas, magnesite	7649	6551	14058	23307	19144
650-2	Fire proof materials other than bricks	66	204	249	66	863
651-A1	Graphite crucibles	183	141	148	284	21
651-B1	Crucibles in any other material than graphite	11	2	11	7	0.8
651-B2	Fire-proof Piping and other manufactures	352	253	214	1219	254

Calculation of Demand of Refractory Materials

Iron and Steel Plant at Esfahan

Iron and Steel Plant at Esfahan will be the biggest consumer of refractory materials in Iran in the future. According to the Technical and Economic Report the demand of refractory materials will be as follows:

	1st Stage	2nd Stage	3rd Stage
Fireclay products - bricks etc. Tons	20,900	57,100	113,993
Tar-bonded dolomite refractories "	8,950	20,000	40,000
Magnesite and chrome-containing refractories "	2,690	6,953	14,903
Silica products "	60	35	60
Zirconium inserts proportioners "	30	95	200
Blocks of electr. melted corundum "	-	16	36
Carbon and graphitized blocks "	240	280	560
Tripoli bricks "	-	40	80
Tap hole sealing lining etc. compound for the blast furnace plant Tons	3,200	8,000	16,000
Refractory dry mortars, powders and milled clay "	4,980	11,581	24,368
Total for refractories Tons	41,050	104,100	210,200

In the above mentioned Technical and Economic Report it was proposed to build on the site of Iron and Steel Plant at Esfahan one plant for production of refractory materials with the following production programme and capacity.

	1st Stage	2nd Stage	3rd Stage
Fireclay products - bricks etc. Tons	20,900	47,000	47,000
Tar-bonded dolomite refractories Tons	8,950	20,000	40,000
Tap hole sealing lining etc. compound for the blast furnace Tons	3,200	8,000	16,000
Refractory dry mortars, powders and milled clay Tons	4,850	9,500	20,100
Total production of refractories Tons	37,900	84,500	123,100

Other refractory materials, i.e. magnesite and chrome-containing refractories, silica products, zirconium inserts, blocks of electrically melted corundum carbon and graphitized blocks and tripoli bricks will be procured from other resources (import, other local production).

Other Iron and Steel Basic Industries

Two other plants in operation (IRMCO Ahwaz and Ahwaz Rolling and Pipe Mill) have low consumption of refractory materials as they are only heating billets and then rolling them. When two elctric melting furnaces will be put to operation in IRMCO Ahwaz, the consumption of refractory materials will be higher. The highest consumption of refractory materials will be in new plants for production of billets and shapes and alloy steels.

Forecast of Demand of Refractory Materials in Other Iron & Steel Basic Industries

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
IRMCO Ahwaz Tons	8,300	8,600	9,000	10,000
Ahwaz Rolling and Pipe Mill Tons	280	280	600	600
Billets, Shapes- new plants "	-	-	30,000	90,000
Alloy steels "	-	-	3,000	6,000
Seamless pipes, new plants "	-	-	200	200
	8,580	8,880	44,800	106,800

Non Ferrous Metals

The forecast of demand of refractory materials for non-ferrous metals (copper, aluminium, zinc, lead) is as follows

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials	tons	120	1060	1600	1700

Ferro-Alloys

The forecast of demand of refractory materials for ferro-alloys is based on the following ratio:

Ferro-Silicon, Ferr-Manganese, Ferro-Chrome - 3 kg of refractory materials/ton of products

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials	tons	-	-	220	380

Cement Factories:

The calculation of the demand of refractory materials for cement factories is based on the ratio of consumption of refractory materials (in kg) to production of 1 ton of cement. In the best factories in Europe and the USA recently this ratio is 0.84 kg up to 0.9 kg of consumed refractory materials to 1 ton of produced cement. For Iranian cement factories this ratio was adopted as follows:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Ratio-consumed refractory materials in kg: 1 ton of produced cement	1.5	1.4	1.3	1.2

Based on the above given ratio, the demand of refractory materials in cement factories will be:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials tons	5,550	10,500	17,400	24,360

Most of the above given refractory materials are fire clay products.

Food Industry

The demand of refractory materials for food industry is low (mostly ... ar factor ...st. The calculation is based on technological projects of these factories.

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials	tons	4,100	4,700	5,700	6,700

The whole quantity of refractory materials are fireclay products.

Foundries

The calculation of the demand of refractory materials for foundries is based on the ratio of consumption of refractory materials (in kg) to production of 1 ton of castings.

This ratio depends on technological process and production programme i.e. differs in wide ranges from 9 kg/ton up to 100 kg/tons. The average ratio in Iran will be approximately 20 up to 30 kg of refractory materials to 1 ton of castings.

Forecast of Demand of Refractory Material in Foundries

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory material	tons	2,240	3,630	5,760	8,400

Most of the above given refractory materials are fire clay products.

Ceramic Industry

The consumption of refractory materials in ceramic industry differs in wide ranges according to the type of products, type of furnace and saggars used in production process. One example: Production of utility chinaware, saggars made of chamotte - the ratio is approximately 1.5 tons of saggars and other refractory products to 1 ton of china utility ware. The same production, but saggars made of silicon carbide, the ratio is

180 kg of refractory material to 1 ton of products. Fire clay refractory material (chamotte) is mostly produced in the factory; special refractory materials are purchased outside the factory. The calculation of demand is based on average ratio approximately 250 kg of refractory materials to 1 ton of products.

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials tons	40,000	60,000	85,000	115,000

Other Industries

Other industries using refractory materials are glass industry, chemical industry, energetical industry, production of lime and plaster of Paris.

Forecast of Demand of Refractory Materials for Other Industries

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Refractory materials tons	8,000	12,600	18,400	25,000

Consumption of refractory clays for space heaters, stoves, etc. was not taken into consideration as the quantity used is small and the clays are not processed. Also in glass industry some components and parts made of fire clay are produced in the factory.

Recapitulation of Demand of Refractory Materials

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Iron & Steel Plant at Esfahan	20,500*	78,000**	158,000**	210,200
Other Iron & Steel Basic Industries	8,580	8,880	44,800	106,800
Non-Ferrous Metals	120	1,060	1,600	1,700
Ferro-Alloys	-	-	220	380
Cement Factories	5,550	10,500	17,400	24,360
Food Industry	4,100	4,700	5,700	6,700
Foundries	2,240	3,630	5,760	8,400
Ceramic Industry	40,000	60,000	85,000	115,000
Other Industries	8,000	12,600	18,400	25,000
Total	89,090	179,370	337,280	498,540

* Production of steel - 50% of the first stage.
** Production of steel - 75% of the second and third stages.

It is presupposed that even in the future the ratio of aluminosilicate refractory products (fire clay products - chamotte) to other refractory products will remain high i.e. 70% - 65%. The demand of other refractory materials in 1356 (1977/8) will be in most cases lower than threshold, but the production is also mostly limited by raw materials available in Iran.

1. Aluminosilicate products (fire clay products - chamotte)

Iran has a number of deposits of fire clays suitable for the production of refractory products, therefore it is advisable to produce aluminosilicate products in the country.

Forecast of Demand of Aluminosilicate Products

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Aluminosilicate products tons	63,000	120,000	225,000	325,000

In the case the factory for the production of refractory materials will be built as a part of Iron and Steel Plant in Esfahan, and the existing factory, Tile Manufacturers in Amin Abad will double its production and ceramic industry will continue in the practice to produce aluminosilicate products for own consumption, the production and uncovered demand will be as follows

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production of Aluminocilicate products tons	11,000	69,000	115,000	135,000
Uncovered demand of Aluminosilicate products tons	52,000	51,000	110,000	190,000

Uncovered demand of aluminosilicate products is higher than threshold (approximately 25,000 - 30,000 tons/year for modern factory) and therefore it is advisable to build new factory with capacity of 30,000 - 40,000 tons per annum in the Fifth Five-Year Plan and either to extend the capacity in the Sixth and Seventh Five-Year Plans, or to build new plants.

2. **Siliceous Refractory Materials (Dinas)**

The demand of siliceous refractory materials is and will be lower than the threshold and therefore it is not recommended to build a factory for these refractory products.

3. **Magnesite Refractory Materials**

3.1 **Dolomite Refractory Materials:**

Iran has deposits of dolomite suitable for the production of refractory products, therefore the production of dolomite refractory products could be included in the production programme.

Forecast of Demand, Production, and Uncovered Demand

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand of dolomite refractory material tons	5,800	18,000	42,000	66,000
Production of dolomite refractory materials tons	-	8,950	20,000	40,000
Uncovered demand of dolomite refractory material tons	5,800	9,050	22,000	26,000

Uncovered demand will be over threshold in 1361 (1982/3), therefore in the Sixth Five-Year Plan new capacity is needed.

3.2 **Magnesite Refractory Materials**

Mineral magnesite is available in Iran (there are already two mines in operation) but it is not known its suitability for production of magnesite refractory materials. It is presupposed that the production of these refractory materials will start with production of chrome-magnesite and chromite refractory materials (see below).

4. **Chromite Refractory Materials:**

As mineral chromite is available in Iran and is of good quality for production of refractory materials it is presupposed that the production of chromite and chrome-magnesite refractory materials will start soon with production of magnesite refractory materials.

Forecast of Demand of Magnesite, Chrome-Magnesite and Chromite Refractory Materials

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand of Refractory Materials tons	3,000	7,500	17,000	27,000

The demand of magnesite, chrome-magnesite and chromite refractory materials will be higher than threshold in the sixth Five-Year Plan, the new factory, having capacity of approximately 20,000 tons should be built in the Sixth Five-Year Plan.

Carbon Refractory Materials:

Zirconium Refractory Materials

Oxide Refractory Materials:

Nitride Refractory Materials:

Because the demand of all these refractory materials will remain below the threshold even in the Seventh Five-Year Plan, it is therefore not recommended to produce these refractory materials in Iran.

Silicon Carbide Refractory Materials:

The demand of silicon carbide refractory materials will remain below the threshold even in the Seventh Five-Year Plan, but as the silicon carbide is primarily used for production of abrasives - see Abrasives, it would be possible to produce silicon carbide refractory materials at the end of the Fifth or at the beginning of the Sixth Five-Year Plan.

Manufacture of Sun-dried Bricks - Code No. 3315

Sun dried bricks are produced without any machinery and equipment. In future these bricks will be replaced by fired bricks.

Code 332 GLASS INDUSTRY

Code No. 3321 Manufacture of flat glass - window glass, safety glass.

Code No. 3322 Manufacture of direct moulded or blown glass i.e. bottles, lamp chimneys etc.

Code No. 3323 Manufacture of cut articles, mirrors, cut glass etc.

Code No. 3329 Miscellaneous manufacture of glass.

The basic raw materials for production of soda-lime-silica glass, used for the bulk of common glass articles are as follows:

Silica Sand - is the most important component, as common glass has a content of 60 - 80% SiO_2. The best sands for glass are those which have the highest content of SiO_2 and the lowest content of Fe_2O_3, and a suitable grain size. Silica sands of acceptable quality for production of glass are rare in Iran (see J. Semsch: The Utilization of Sands from the Shores of the Caspian Sea), and in place of silica sands quartzite is generally used in Iran.

Lime - is used to extent of approximately 6 - 12% in common glasses. Raw materials from which lime is produced are limestone and dolomite, both of which are found in Iran in an acceptable quality.

Soda (Na_2O) In the proportion of approximately 12 - 17% is used in common glasses, in the form of sodium carbonate (soda ash), sodium sulphate and sodium nitrate. Currently these chemicals are imported, but in about 3 years they will be produced in Iran.

Commercial glass contains other oxides including aluminium and magnesium oxides in form of feldspar, nephelite, syenite and cryolite, and other special ingredients to help in oxidizing, fining or decolorizing the glass batch. Colours in glasses are produced either by solution or by the separation from the clear melt of finely divided particles of material (Fe_2O_3, MnO_2, Cr_2O_3, K_2CrO_4, CoO, CuO, NiO, UO_3, Ag_2O, $AuCl_3$, FeS, SeO_2, SeO_3 CdS etc.)

[illegible] If necessary, raw materials go through a preparation [illegible] such sands are sieved and dryed, or in the case of lime[illegible] [illegible] they are crushed and sieved. The prepared [illegible] [illegible] in bins, from which a batch is weighed to pro[illegible] [illegible] mixed in a mixer or in the case of small plants mixed [illegible] [illegible] to a storage bin.

[illegible] pots are used they are filled manually by shovel, [illegible] tank furnaces using a continueous process they are fed [illegible] a screw or pusher type feeding device.

[illegible] Glass made in small quantities is melted in [illegible] containing 2 - 12 pots. Pots are made of a mixture [illegible] and "Grog" (prefired clay). The pots are formed by hand, [illegible], heated to a prescribed temperature and then filled by [illegible] of glass which is melted in it. There are only 2 pot furnaces in [illegible]. A small quantity of glass is produced in "day tanks" [illegible] small furnaces in which the glass is melted. Glass produced [illegible] quantities overnight and worked during the next day is melted [illegible] furnaces, the biggest of which are designed for continueous pro-

[illegible] of the glass furnaces in Iran are fired by fuel oil, but in [illegible] of natural gas may be expected.

[illegible] The hand blowing process is used with pot[illegible] [illegible] tank furnaces. The glass is gathered in the blow [illegible] and then blown either without a mould or with a mould to the final [illegible]. This process is in common use in Iran in small factories for [illegible] production of bottles, lamp chimneys etc.

[illegible] Blowing Process - The use of a blow pipe operated by com[illegible] [illegible] in use in Iran.

[illegible] Process with automatic feeding is used only in pro[illegible] [illegible] bottles and tumblers in Iran (see Code No. 3322).

[illegible] of Glass - This method is not used in Iran.

Pressing of Glass - In small factories the feeding of glass to moulds is by hand and the operation of pressing is also by hand. In bigger factories mechanical presses are used with hand feeding. The automatic pressing process including both feeding and pressing is used in Iran only in combination with other processes - see production of bottles (Code No. 3322).

Rolling of Glass - Some sheet glasses are produced by rolling and this process will be used for the first time in the new factory of Abgineh Co. Ghazvin (see Code No. 3321).

Drawing of Glass - The drawing process is used in the production of flat glass and tube glass. There are various types of drawing machines for the production of flat glass, but only Fourcault and Pittsburgh machines are used in Iran.

Special processes are designed for the production of glass wool and glass textile fibre.

Processes Applied after Formation:

Annealing - Glassware after shaping must be cooled very slowly to be relieved from stresses. This is carried out either in chamber kilns in batches or in tunnel kilns as a continueous process.

Fire Finishing - The edges are heated in a flame till fusion rounds them.

Edge Grinding - The edges are ground on grinding machines with either a horizontal or a vertical shaft.

Other processes used after formation are decorative paintings, ice-flower patterns, etching, decorative cutting (grinding), enamelling, silvering, coppering, gilding etc.

There are 35 factories in Iran at present producing different kinds of glass products each employing more than 10 workers. The total number of workers employed in 1349 (1970/1) was 2552.

Code No. 3321 Flat Glass Manufacture - Window Glass and Safety Glass

1. Window Glass

There are only two factories in Iran at present producing window glass by vertical drawing.

1.1 Iran Glass Co, Teheran (Shisheh Iran)

The oldest glass plant in Iran has 3 vertical drawing machines, 20 years old, working from a 60 ton/day capacity glass tank furnace. It produces windown glass of 2,0 - 3,0 mm thickness. In the year 1346 (1967) production was 1,184,000 sq.m. of window glass, in 1347 (1968) production was 966,510 sq.m., and in 1348 (1969) output was approximately 9000 tons or 1,500,000 sq.m. The number of workers employed in 1349 (1970/1) was 394. For the production of flat glass on vertical drawing machines a new furnace having a capacity of 9000 tons a year was completed at the end of 1350 (1972).

1.2 Ghazvin Glass Co. - Ghazvin

Production at this new plant started in the year 1347 (1968) with 3 furnace vertical drawing machines fed by one tank furnace with a continuous production capacity of 10,000 sqm/day i.e. approximately 12,000 tons/year. The plant is fully mechanized. A second furnace for continuous production in conjunction with a Colburn horizontal drawing machine was completed in 1350 (1972) for the production of windown glass, thickness 2 - 6 mm, capacity 10,000 sqm/day i.e. 18,000 tons/year. The number of workers employed in 1349 (1970/1) was 243. A third furnace is under construction for the production of window glass with a Colburn horizontal drawing machine, capacity 15,000 tons/year. The furnace will be in operation in 1351 (1972/3).

1.3 Abgineh Co. Ghazvin

This is a new plant, at present under construction, and production is expected to start in 1351 (1972). The planned capacity is 20000

tons of sheet glass, thickness 1 - 20 mm, of which 5000 tons/year will be window glass, 7000 tons will be rolled glass and 8000 tons safety glass. In the Fifth Five-Year Plan the plant will be extended by a new tank furnace and machinery and equipment for the production of 18000 tons/year of flat glass.

Import of Flat Glass in tons - According to the Foreign Trade Statistics of Iran

Tariff No.		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
665B	Cast & rolled glass, sheets and plates	3501.4	4203.5	3415.5	3868.2	4387.8	3543.3
665C	Rolled wire glass	72.6	134.2	199.5	61.9	96.1	89.4
666	Rolled, drawn window glass sheets	11057.0	13188.6	15093.3	12064.9	3705.1	6048.0
667A	Bent, curved sheet glass	10.6	19.9	13.9	21.5	7.2	14.8
667B	Unpolished sheet glass, frosted glass	290.5	133.1	199.7	74.4	51.4	34.6
667C, D	Sheet glass ground, polished, engraved, gilt decorated	18.6	38.9	19.4	18.7	52.6	38.5

Capacity, Production, Imports, Exports and Consumption of Flat Glass (tons) According to the Research Centre for Industrial & Trade Development of the Ministry of Economy

Year	Capacity	Production	Consumption	Exports	Imports
1344 (1965/6)	13,000	5,022	18,084	-	13,062
1345 (1966/7)	13,000	5,153	19,449	-	14,299
1346 (1967/8)	13,000	6,512	23,791	-	17,279
1347 (1968/9)	25,000	13,130	31,490	-	18,477
1348 (1969/70)	25,000	17,746	32,679	-	15,933
1349 (1970/1)	43,000	21,883	29,959	17	8,093

According to the Research Centre for Industrial and Trade Development of the Ministry of Economy, import of rolled sheet glass was as follows:

	1344 (1965/6)	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)
Rolled sheet glass tons	3293	3238	4089	3383	3800

Forecast of demands of plain and rolled glass has been made by the author of this study on the base of the following assumptions:

1. Covered area of buildings in sq. m. given in Code No. 400 - Construction of Building.

2. Consumption of sheet glass in sq. m. and kg of covered area as follows:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)
New private construction of housing buildings - sq. m. of sheet glass/sq. m.	0.12	0.15	0.175
kg " " " /sq. m.	0.72	0.90	1.05
New private construction of industry and trade buildings - sq. m. of sheet glass/sq. m.	0.15	0.175	0.2
kg " " " /sq. m.	0.9	1.05	1.2
New public construction of housing and city buildings - sq. /m. of sheet glass/sq. m.	0.175	0.20	0.225
kg " " " /sq. m.	1.05	1.2	1.35
New public construction of industry sq. m. of sheet glass/sq. m.	0.2	0.228	0.25
kg " " " /sq. m.	1.2	1.35	1.5

Forecast of consumption, Capacity and Production of Flat Glass (tons)

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1368 (1987/8)
New private construction of housing buildings	20210	35840	52810	
New private construction of industry and trade buildings	1990	4400	8920	
New public construction of housing and city buildings	6390	11520	23400	
New public construction of industry	4060	9000	19120	
Subtotal	32650	60760	104050	160000

(Cont'd)

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Repairs approximately 25% from subtotal	8130	15140	26030	40000
Rolled sheet glass	5200	8600	14250	23800
Sheet glass for production of safety glass including 10 % for scrap	3520	6600	10670	16200
Total consumption	49500	91000	155000	240000
Production	40000	85000	150000	240000
Installed capacity	63000	81000	81000	81000
New Capacity	-	20000	80000	160000

2. Safety Glass

Tempered Safety Glass - Glass plates are heated below their softening point and then cooled with a blast of air. On impact tempered safety glass should break into uniformly small pieces.

Laminated Safety Glass - A sheet of vinyl plastic is placed between the sheets of glass and all are bound together by heat and pressure.

There is only one plant in Iran at present producing safety glass.

2.1 Miral Co. Teheran

This is a new plant, having an installed capacity of 180,000 sq.m. of tempered safety glass/year and 120,000 sq.m. laminated safety glass/year for cars, lorries, doors etc. In the near future a new line is to be installed, having a capacity of 100,000 sq.m. of laminated safety glass/year. At present, the utilization of installed capacity is low and in the year 1348 (1969/70) production of safety glass was approximately 120,000 sq.m., or 90% of installed capacity.

Both types of glass are prepared from imported manufactured glass, and at miral the glass is cut to shape, the edges finished followed by either tempering or laminating of the sheets. In future, it will be possible to use local sheet glass.

2. Abgineh Co. Ghazvin

In the near future safety glass will also be produced by Abgineh Co., Ghazvin. The planned capacity of this plant is 1000 tons/year of laminated safety glass, 2000 - 3000 tons/year of tempered safety glass for doors.

Import of Safety Glass - According to the Foreign Trade Statistics of Iran

Tariff No.		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
669-1	Safety glass for motorcars kg	214,028	357,563	524,521	411,578	169,700	197,600
669-2	Other safety glass kg	14,951	36,457	104,138	20,264	7,000	.100

Production of Safety Glass According to the Research Centre for Industrial and Trade Development of the Ministry of Economy

	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)
Production tons	800	1000	1000	1800

The average area of safety glass for cars is 2.8 sq.m., buses 15 sq.m., minibuses 6 sq.m. and trucks and vannettes 2.5 sq.m. On this basis the consumption of safety glass in Iran was forecasted.

Forecast of Consumption, Production and Installed Capacity of Safety Glass in Iran

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Consumption of Safety Glass for:					
New passenger cars	1000 sq.m.	126.0	252.0	420.0	644.0
New buses	1000 "	14.4	22.5	27.0	36.0
New Minibuses	1000 "	11.4	15.6	18.0	21.6
New trucks and vannettes	1000 "	38.0	73.0	112.5	190.0
Subtotal	1000 "	189.8	363.1	577.5	870.6
	tons	2260	4330	6930	10400
Entrance doors	1000 sqm.	5.6	12.0	22.0	36.0
	tons	140	300	550	900
Total	tons	2400	4630	7480	11300
Repairs & spare parts approximately 30% of total	tons	800	1370	2220	3400
Grand Total	tons	3200	6000	9700	14700

(Cont'd.)

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production	tons	3200	6000	9700	14700
Existing capacity	tons	13000	13000	13000	13000
New capacity	tons	-	-	-	5000

Code No. 3322 - Manufacture of Direct Moulded or Blown Glass

This code number covers several different products:

1. Production of Bottles

The production of bottles in Iran according to the Bureau of Statistics of the Ministry of Economy:

Year	Production/pcs/year
1342 (1963/64)	17, 600, 000
1343 (1964/65)	26, 144, 000
1344 (1965/66)	24, 836, 000
1345 (1966/67)	27, 580, 000
1346 (1967/68)	27, 902, 000
1347 (1968/69)	37, 402, 000

Import of Bottles, Carboys and Flasks in Kg. According to the Foreign Trade Statistics of Iran

Year	Bottles	Carboys and Flasks
1345 (1966/7)	432, 059	33, 280
1346 (1967/8)	1, 287, 124	266, 372
1347 (1968/9)	1, 586, 094	64, 463
1348 (1969/70)		
1349 (1970/1)	2, 051, 252	73, 871
1350 (1971/2)	1, 780, 662	11, 499

There are 10 glass factories in Iran at present, producing bottles, of which the largest are as follows:

Shisheh Va Gas Co. Teheran

This is the biggest producer of bottles and tumblers in Iran. The installed capacity is 100,000 bottles/day and 750 gross of tumblers/day, and production in the year 1346 (1967/8) was 9,205,000 bottles at which time only two tank furnaces were in operation. The number of workers employed in 1349 (1970/1) was 249. The installed plant comprises mechanical batch preparation consisting of a crusher, 2 mixing machines, and conveyors, 3 continuous process tank furnaces with feeders, 5 automatic machines for the press and blow process and a blow and blow process with 3 automatic feeders. The next operations are fire finishing, printing the name of the product, and annealing. All operations are in continuous lines.

The Company has ordered a new tank furnace, two new automatic "Hardford 28" machines with automatic feeders for the production of tumblers and an automatic type IS bottle making machine. The Hardford machines each have a capacity of 500 gross tumblers a day. All tank furnaces are fired by fuel oil. A small quantity of bottles is sold to other firms, but most of the production is consumed in the factory for bottling aerated drinks.

1.2 Iran Glass Co. Teheran (Shishe Iran)

This is the second largest producer of bottles in Iran. It is equipped for the production of bottles and has one tank furnace for continuous process and 3 automatic Hardford machines. Batch preparation and all other operations are fully mechanized.

The production of bottles in the year 1346 (1967/8) was 6,357,000 pieces.

1.3 Shams Brewery Teheran:

This factory has 2 day tank furnaces, each with 6 semi-automatic machines for the production of beer bottles. Only one furnace is in operation and the other is repaired and kept in reserve. Production

in 1346 (1967/8) was 2,500,000 bottles, representing the largest production of bottles using semi-automatic machines in Iran. The total number of workers employed in 1349 (1970/1) was 54.

1.4 Zangiran Glass Co. and Pars Glass Co. Teheran

These two bottle factories are now working on a joint basis. Each factory has one tank furnace for continuous process with [illegible] automatic machines for the production of bottles. In 1346 (1967/8) the production of bottles by Zangiran Glass Co. was 1,200,000 pieces and by Pars Glass Co., 990,000 pieces. In 1349 (1970/1) the total for both factories will reach 3,000,000 bottles.

1.5 Tavakol Glass Co. Teheran:

This factory has one day tank furnace with 4 semi-automatic machines (feeding by hand). Small batches of bottles are also produced by hand blowing. Production was 1,020,000 bottles in 1346 (1967/8); and there were 25 workers employed in 1349 (1970/1).

1.6 Mehrabian Glass Co. Teheran:

The production of bottles in this factory in 1346 (1967/8) was 2,072,000 pieces using semi-automatic blowing. The number of workers employed in 1349 (1970/1) in this factory was 17.

1.7 Mina Glass Co. Teheran:

This factory constructed in 1346 (1967/8) has one tank furnace for the manufacture of bottles. The existing capacity is not known, but the factory employed 170 workers in 1349 (1970/1).

Forecast of Production of Bottles in Iran (in 1000 pcs and tons)

Year	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Bottles in 1000 pcs	39600	76300	128000	200000
in tons	9200	19100	32000	50000

Forecast of production of bottles is based on the following assumptions

1) At the year 1361 (1972/3) 100% of soft drinks and alcoholic beverages, 90% of beer, 80% of liquid dairy products, 70% of other liquids such as vinegar, distilled water, vegetable oil etc., and 50% of compots and jams will be bottled to glass bottles.

2) In the year 1366 (1987/8) - 70% of soft drinks and alcoholic beverages, 60% of beer, 40% of liquid dairy products and 30% of other liquids, compots and jams will be bottled to glass bottles.

3) Figures for the year 1356 (1977/8) and 1361 (1982/3) were interpolated.

4) Each bottle will be used - for pharmaceuticals and perfumes once
- for compots and jams 6 - 10 times
- for alcoholic beverages 5 - 6 times
- for beer 20 - 25 times
- for soft drinks 35 - 40 times
- for liquid dairy products 30-40 "
- for other liquids 6 - 10 times

There are 2 other small glass factories producing bottles - Sedaghat Glass Co., with 49 workers, Mojarab Glass Co., with 10 workers. Production is 300,000 - 500,000 pieces/year by hand blowing.

2. Production of other blown or pressed Glass Ware:

There are 9 factories in Iran producing blown or pressed glass ware, such as ashtrays, tea-cups, jugs, tumblers, lampshades, plates etc. All these factories prepare batches by hand, having day-tank furnaces fired by fuel oil and one or more hand operated presses with hand feeding. Other operations are mostly undertaken by hand.

2.1 Iran Bolour Glass Factory Teheran

This factory was producing blown and pressed [illegible] In 1346 (1967/8) production was [illegible] tea-cups, tumblers, plates, ashtrays etc. [illegible] tank furnaces installed with a [illegible] This factory is now closed and the proprietor is considering a new production programme.

2.2 Omid Glass Factory Teheran

The factory has four day tank furnaces [illegible] of which three are in operation, and one is held in reserve. [illegible] tank furnace for continuous production which was [illegible] There are 14 hand operated presses of various types [illegible] eight were in operation. Semi-automatic machines for the production of tumblers, installed two years ago are out of production because they are unable to compete with the automatic machines installed by Shishe Va Gas Co. Annealing is carried out in two continuous tunnel leers, oil fired, with 10 chamber furnaces. Dyes and tools are heated in 4 small movable furnaces. [illegible] are 5 fire finishing machines and 11 edge grinding machines. As most of the products are painted, there is an electrically heated continuous tunnel leer. In 1346 (1967/8) production was 3000 tons, but it is now reduced to approximately 1500 tons/year. It is the biggest factory of this type in Iran, employing 380 workers in 1349 (1970/1).

2.3 Sarvary Glass Factory Teheran:

The factory has one oil heated day-tank furnace, and is producing chemical glass by hand blowing. Production in 1346 (1967/8) was 400,000 pieces, and in 1348, 480,000 pieces.

2.4 Motahed Glass Factory Teheran:

The factory has one oil heated day tank furnace. It is producing blown and pressed glass ware by hand blowing and hand pressing. Production in 1346 (1967/8) was 2,250,000 pcs. The number of workers employed in 1349 (1970/1) was 94.

Other smaller firms, producing blown or pressed glass ware are Vatan Glass Co. Teheran, Sedaghat Glass Co. Teheran, Sholeh Glass Co. Teheran, Zogagi Glass Co. Teheran, Zavieh Glass Co. Teheran, Dour Andish Glass Co. Teheran, etc.

According to the Bureau of Statistics of the Ministry of Economy, production of tumblers in the year 1347 (1968/9) was 15,938,000 pcs.

Forecast of Production of Tumblers:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production of tumblers 1000 pcs.	21000	30000	42000	60000

Forecast of production of tumblers has been made by the author of this study on the basis of the production in the year 1347 (1968/9). Projected growth rates were derived by correlation with expected levels of gross material product.

3. Production of Lamp Chimneys:

According to statistics from the Ministry of Economy, the production of lamp chimneys in Iran was as follows:

Year	Production pcs/year
1342 (1963/4)	40,960,000
1343 (1964/5)	20,997,000
1344 (1965/6)	23,413,000
1345 (1966/7)	16,149,000
1346 (1967/8)	9,250,000
1347 (1968/9)	10,524,000

Lamp chimneys have not been imported in recent years. In the next few years production will decrease as the electrification of Iran continues and oil lamps are replaced by electric lamps or by propane-butane lamps.

There are 5 glass factories producing lamp chimneys in Iran, of which the largest are:

3.1 Hussein Farzony Glass Factory Teheran

The production of lamp chimneys was 3,000,000 pieces in 1346 (1967/8). There is one "day tank furnace" and lamp chimneys are produced by hand blowing. The firm was employing 42 workers in 1349 (1970/1).

3.2 Etminan Glass Factory Teheran:

This factory produced 1,300,000 pieces of lamp chimneys in 1346 (1967/8). Lamp chimneys are produced by hand blowing, using one day-tank furnace and 36 workers were employed in 1349 (1970/1).

3.3 Shafagh Glass Factory Teheran:

This factory produced 1,750,000 pieces of lamp chimneys in 1346 (1967/8). There is one day-tank furnace and lamp chimneys are produced by hand blowing and 17 workers employed in 1349 (1970/1).

3.4 Motafegh Brothers Glass Factory Teheran.

This factory produced 1,300,000 lamp chimneys in 1346 (1967/8). There is one day-tank furnace and chimneys are produced by hand blowing. The firm was employing 56 workers in 1349 (1970/1).

Other producers are: Momtaz Glass Factory, Teheran - 44 workers (700,000 pcs/year). Alborz Glass Factory, Teheran, 41 workers, (700,000 pcs); Sedaghat Glass Factory, Teheran, (36,000 pcs/year).

The forecast of production of lamp chimneys by the Research Centre for Industrial and Trade Development of the Ministry of Economy for the Fifth Five-Year Plan is - 1351 (1972/3) - 26,788,000 pcs.
1356 (1977/8) - 29,721,000 pcs.
This forecast is high, since oil lamps in the near future will be partly replaced by electric lamps or propane-butane lamps.

Forecast of Production of Lamp Chimneys

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production	1000 pcs.	12000	10000	9000	8000

The reduced requirements are in proportion to the planned installation of electric supply in domestic dwellings (see Electric Power Industry).

4. Production of Glass Bulbs and Tubes:

Production of glass bulbs for incandescent lamps and tubes for flueresсent lamps, has not started in Iran but a factory, Pars Toshiba Co., Rasht is under construction in collaboration with Toshiba, Japan. Production will start in 1350. There will be one tank furnace, capacity 8 tons/day, for continuous production which for 172 days a year will produce bulbs for incadescent lamps, for 134 days a year tubes for fluorescent lamps, and for 30 days a year stem, exhaus tubes and cane glass. The production in the first stage will be 11,000,000 bulbs, 2,200,000 tubes and 110 tons of stem, exhaust tubes and cane glass.

In the next stage, a second new tank furnace will be installed and production will then be 16,500,000 bulbs for incandescent lamps, 3,300,000 tubes for fluorescent lamps and 165 tons of stem, exhaust tubes and cane glass.

Another plant for the production of glass bulbs and tubes will be set up after 1351 (1972) in collaboration with Philips Co. and the GEC (England). The capacity in the final state will be 16,000,000 incandescent lamps and 1,600,000 fluorescent lamps.

Import of incandescent lamps, fluorescent lamps and neon tubes was:

Year	Incandescent Lamps	Fluorescent Lamps and Neon Tubes
1344 (1965/6)	611,037 kg	317,982 kg
1345 (1966/7)	635,609 kg	518,752 kg
1346 (1967/8)	1,292,170 kg	396,738 kg
1347 (1968/9)	974,766 kg	318,255 kg

Forecast of Demand of Incandescent Lamps, Fluorescent Lamps and Neon Tubes

Year	Incandescent Lamps	Fluorescent Lamps
1354 (1972/3)	28,000,000	2,400,000
1356 (1977/8)	52,000,000	5,000,000
1361 (1982/3)	80,000,000	8,000,000
1366 (1987/8)	120,000,000	13,000,000

There will be a need for a new plant in 1355 (1976/7) or the existing plants will need to be expanded.

5. Ampules:

P.A. Company, Teheran are producing ampules from imported glass. This firm imported 120 tons of glass tubing in 1348 (1969/70) and produced 20,000,000 glass ampules with capacities of 1 cc, 2 cc, 5 cc and 10 cc. The total consumption of glass ampules was 70,000,000 pcs, of which 50,000,000 were imported and 20,000,000 were produced locally.

Darou-Pakhsh Co. Teheran (pharmaceuticals) is installing a new line for the production of ampules from imported glass tubing, having a capacity of 40,000,000 ampules per year in one shift. Production will start in 1350 (1972) and it will soon be doubled to two shift production. In 1351 (1972/3) Irans ampule requirements will be fully met by local production.

5. Fibre Glass:

There is one factory in Iran at present producing fibre glass.

Iran Fibre Glass Co. Teheran:

This factory is producing fibre glass for insulation purposes, and production was 312 tons in 1346 (1967/8) and 720 tons in 1348 (1969/70). There were 90 workers employed in 1349 (1970/1).

Machinery and Equipment consisted of one oil heated tank furnace and one centrifugal machine for production of fibres.

Code No. 3323 - Manufacture of Cut Articles, Mirrors, Cut Glass etc.

1. Production of Mirrors:

There are many small shops producing mirrors from imported or from Iranian glass, but only one producer is producing mirrors on a medium scale:

Tavakoli va Amoghli, Teheran:

This firm is producing mirrors from imported flat glass. The production in 1346 (1967/8) was 1550 sq. m. of thickness 3mm, 1869 sq. m. of thickness 4 mm, and 1650 sq. m. of thickness 6 mm; total 5060 sq. m. a year. The number of workers employed in 1349 (1970/71) was 10.

Import of Mirrors according to the Foreign Trade Statistics of Iran

Tariff No.		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)
668A1-668B6	Mirrors, tin, silver, platinum coated kg	12059	47376	70027	44411	91256
668B7	Mirrors for cars kg	10332	20323	19751	22457	27888

In future there will be a possibility of installing a new plant with modern machinery and equipment.

2. Cut Glass

There are a number of firms in Iran engaged in the cutting glass, producing mainly parts for chandeliers. There are only two medium scale firms:

2.1 Sholeh Glass Co. Teheran:

The firm is cutting glass from imported and from Iranian glass. Production in 1346 (1967) was 200 tons.

2.2 Rahmani Glass Co. Teheran:

This firm is cutting parts of chandelliers, and was employing 10 workers in 1349 (1970/1).

Code No. 333 Manufacture of Pottery, China and Earthenware

Code No. 3331 Manufacture of Pottery
Code No. 3332 Manufacture of China and Porcelain and Earthenware
Code No. 3339 Miscellaneous Manufacture of Pottery, China and Earthenware

Code No. 3331 Manufacture of Pottery

There are hundreds of small shops producing glazed or unglazed pottery products such as flower pots, plates, dishes, bowls, jugs, vases etc., and some are well decorated in the Persian style. According to the Statistical Department of the Ministry of Economy the production of pottery in Iranian cities in recent years has been as follows:

Year	1344 (1965/6)	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)
Production of pottery in 1000/pcs.	12,721	13,863	15,510	20,636

Pottery shops are often located in rural areas, and since there are no statistics giving the number of rural shops and their total production, the figures quoted represent only a part of total production.

Description of Existing Machinery, Equipment and Processes

Most pottery production shops in Iran do not have any mechanically driven machines. The clay is dug by hand, watered and trodden by feet and the soft plastic clay is then thrown into a mould on a foot driven potter's wheel and shaped by hand or by template. After shaping, the

formed clay is dried in the open air and fired in a primitive kiln made of fireclay. Only few factories have some mechanically driven machinery.

It is assumed that in each of the five year planning periods, that is, during the fifth, sixth and seventh five-year plans, three or four modern plants each having a capacity of approximately 4,000,000 pieces a year, will be built.

Forecast of Total Demand, Capacity and Production in Modern Plants

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Total demand	1000 pcs.	35,570	62,550	80,000	90,000
Capacity of modern plants	1000 pcs.	-	12,000	24,000	40,000
Production in modern plants	1000 pcs.	-	10,000	22,000	36,000

Using 1347 (1968/9) as the last year and the historical rate of increase of production, figures for years 1351 (1972/3) and 1366 (1987/8) were extrapolated by the author of this study.

Import of Stoneware, Earthenware and China into Iran

Tariff Code No.		1346 (1967/8)	1347 1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
652	Stoneware bricks, slabs, paving over 3 cm. thick kg.	105,064	250,373	107,305	6,008	-
653	Stoneware pipes, pipe joints kg.	17,702	27,987	7,694,330	-	-
654	Stoneware utensils for chemicals or for use in farming kg.	12,686	7,301	2,570	2,544	12,000
655-1	Stoneware slabs, paving, roofing not more than 3 cm. thick kg.	48,951	78,504	160,646	289,282	59,989

Tariff No.			1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
	Ceramic and earthenware slabs, paving, facing not more than 3 cm. thick	kg.	113,227	137,617	137,995	276,910	403,965
[illegible]	Ceramic stove parts	kg.	750	-	337	12	775
[illegible]	Ceramic sanitary fittings	kg.	2,734,888	3,049,700	2,776,039	1,444,663	2,087,658
658	Ceramic statuettes, ornaments, smokers requisites	kg.	43,730	64,735	57,783	2,509	30,725
661A	Household, toilet earthenware	kg.	666,459	483,838	568,672	967,286	1,167,723
661B	Other earthenware	kg.	26,529	41,169	45,809	100,376	520,423
662A	Toilet, household chinaware	kg.	7,285,243	5,051,287	4,767,996	4,720,289	4,805,069
662B	Other chinaware	kg.	46,593	52,323	57,641	43,156	34,645
875A	Ceramics or glass insulators	kg.	1,739,202	258,648	1,537,402	2,316,587	2,393,532

Source : Foreign Trade Statistics of Iran

Stoneware

There is no factory producing stoneware products such as pipes, pipe joints, slabs etc. Raw materials for this industry are available in Iran but consumption is not growing as stoneware is being replaced by other materials, for example, asbestos-cement pipes and joints etc. It is therefore assumed that no factory will be build in the near future.

Household Earthenware and Chinaware

At the present time, there is no factory producing household earthenware and chinaware but ISS Industrial Company in Teheran is decorating imported household chinaware.

There are two factories under construction:

(1) Sherkate Sahami Orkid Iran in Gazvin to which company a licence has been issued for the production of 3000 tons/year but in the first stage of construction the plant will have a capacity of 1500 tons/year. The plant commence operations in 1351 (1972).

(2) Sherkate Sahami Chiny Sazi Pars in Rasht has a licence for the production of 1100 tons/year and will be in operation in 1351 (1972/3).

Description of Machinery, Equipment and Processes

Household chinaware is made of approximately 40-50% of Kaolin, 25-30% of quartz, and 25-30% of feldspar. The quartz and feldspar are crushed in a jaw crusher and an edge runner mill and then all three materials are weighed to provide the correct mix, and milled with water in drum mills. The slurry is sieved, demagnetized, and poured into a blunger from which it is either pumped by a diaphragm pump to a filter press which takes out the free water, or it is pumped to the casting shop to be cast using moulds made of plaster of Paris.

After de-watering in the filter press the mass is mixed in a de-airing pug-mill, extruded through a shaped die and automatically cut-off by a wire cutter. Products such as plates, cups, etc., are then shaped by turning.

The shaped products are dried in a continuous drier, then loaded on kiln cars passing to the biscuit firing tunnel kiln which is fired by crude oil or gas. After firing the baked products are glazed and fired again in a second tunnel kiln also fired by crude oil or gas. Following inspection, the glazed products are decorated and fired for the third time in an electric tunnel kiln. The decorated products are finally inspected, if necessary ground, packed and dispatched.

Forecast of Demand, Capacity, and Production of Household Chinaware

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand	2,800	4,700	7,500	11,200
Capacity	2,600	5,600	7,500	12,000
Production	1,500	4,500	7,200	11,200
Shortage	1,300	200	300	-

Forecast of demand for household chinaware has been made by the author of this study on the basis of growth rates applied to imports and production in the years 1346 (1967/8) until 1350 (1971/2). Projected growth rates were derived by correlation with expected levels of gross national product and by reference to per capita consumption of household chinaware in other countries.

The production forecast for household chinaware by the Research Centre for Industrial and Trade Development of the Ministry of Economy for 1351 (1972/3) is 2000 tons and for 1356 (1977/8) = 5700 tons and this is thought to be too high. Market demand is likely to be less than the forecast production and new plants will not reach their full capacity. An important fact is that household chinaware is now often replaced by plastics.

Ceramic (Porcelain) Insulators

Ceramic (porcelain) insulators are not produced in Iran at the present time, although most insulators used are either porcelain or glass. Plastic insulators are mostly used for indoor equipment, for example for switch boards etc. Tariff code no. 875A gives the imported quantity of ceramic and glass insulators together. It is estimated, that the ratio of porcelain to glass insulators used is about 2 to 1, but this preference may change, making it difficult to estimate future demand. Forecast of demand of all types of insulators see electromechanical industry, insulators.

It is advisable to build one plant in the Fifth Five Year Plan with a capacity of 2500 tons/year and to extend this capacity in the Sixth Five Year Plan or alternatively to build a new plant. On these assumptions, the capacity and production of ceramic insulators will be as follows:

Forecast of Capacity and Production of Ceramic Insulators

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Capacity	tons	-	2,500	5,000	5,000
Production	tons	-	1,800	3,800	5,000

SANITARY CERAMICS

There are two factories in Iran producing sanitary ceramics:

(1) Mina Manufacturing Co. Ghazvin

Production in this plant started in 1350 (1972), with a capacity of 3200 tons per year, or approximately 900 pieces a day of sanitary ceramics. Full capacity is expected to be reached in 1352 (1973/4). The formed clay is fired in a tunnel kiln at a temperature of 1230°C. The factory is collaborating with Pozzi Co. (Italy).

The production programme includes wash basins, toilet bowls, shower basins, and accessories.

(2) Pareceram Vitreous China Sanitary Ware Manufacturing Co. in Varamin

Production started in 1348 (1970), and in 1349 (1970/1) production was approximately 1000 tons/year and in 1350 (1971/2) the plant reached full capacity of 2000 tons/year. The formed clay is fired in a tunnel kiln.

The production programme includes wash basins, toilet bowls, piesoir bowls, bidets and accessories.

The existing factories are equipped with modern machinery and equipment including tunnel kilns.

Forecast of Demand, Capacity, and Production of Sanitary Ceramics

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand	tons/year	8,000	12,600	24,300	40,000
Existing Capacity	tons/year	5,200	5,200	5,200	5,200
New Capacity	tons/year	-	4,500	15,000	33,000
Production	tons/year	4,000	7,400	17,000	33,000
Shortage	tons/year	4,000	5,200	7,300	7,000

The forecast of consumption of sanitary ceramics is based on the following assumptions:-

(a) In the future, houses built of kiln bricks and steel, kiln bricks and wood, reinforced concrete, stone and steel will be equipped with one toilet bowl, and one wash basin, having a total weight of approximately 30 kg.

(b) Additionally, approximately 15% of the houses will be equipped with one additional toilet bowl, one additional wash basin and one bidet, having a total weight of approximately 45 kg.

(c) Buildings used for industry and trade will be equipped with one set of sanitary equipment consisting of one toilet bowl, one wash basin and one urinal bowl, having a total weight of approximately 40 kg. Housing and city buildings will be equipped with one set of sanitary equipment per 160 sq. m., trade buildings will have one set per 400 sq. m., and industry will be equipped with the same set per 600 sq. m.

(d) 8% to 10% of all sanitary equipment will be made from raw materials other than glazed chinaware.

Based on the stated assumptions, the following table gives a detailed estimate of the forecast demand.

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Housing - new houses	tons	4,780	7,350	13,900	23,600
Replacement	tons	1,610	2,350	5,250	7,750
Housing and city buildings - new	tons	1,520	2,400	4,310	7,100
Replacement	tons	450	740	1,570	2,500
Industry and trade - new	tons	110	420	740	1,180
Replacement	tons	30	180	140	480
Industry - new	tons	230	440	850	1,440
Replacement	tons	70	120	240	450
Total	tons	8,800	14,000	27,000	44,500
Deduction 8-10%	tons	800	1,400	2,700	4,500
Total demand of sanitary ceramics	tons	8,000	12,600	24,300	40,000

Description of Machinery, Equipment and Processes

Sanitary ceramics are made of kaolinite mixed with other clays comprising approximately 45-50% of the mix, approximately 45-50% of quartz and 3 to 10% of feldspar. The quartz and feldspar are first crushed in a jaw crusher and then all materials are ground with water in drum mills. The slurry is stored in tanks equipped with agitators, after passing over a magnetic separator and through vibratory sieves, it is pumped by a diaphragm pump to the casting shop to be cast using moulds made of plaster of Paris.

After de-watering, the plaster moulds are opened and the formed products pass to a tunnel drier, manually glazed, and fired in a gas or oil fired tunnel kiln to a temperature of approximately 1280-1300°C. Finished products are then ground, sorted, controlled and packed.

A plaster mould shop for the production of plaster moulds and a seggar shop for the production of saggars and supports made of fire clay refractory materials or silicon carbide, are necessary auxiliary departments.

Cement Plants

Code No. 3341 Manufacture of natural cement
Code No. 3342 Manufacture of portland cement and other similar cements.

All the cement plants in Iran as listed below are producing portland cement.

Cement Plants in Iran (capacity in tons/day)

	1346 (1967/8)	1351 (1972/3)	1356 (1977/8)
Ray	500	500	500
Teheran	1,700	3,700	3,700
Shomal Teheran	400	400	3,400
Mashad	500	500	1,500
Isfahan	1,000	1,000	1,400
Doroud	1,000	2,000	3,500
Lochan	400	400	400
Fars - Shiraz	1,000	1,000	3,000
Jajroud	-	300	300
Kerman	-	300	2,300
Abe-Yek	-	3,500	7,000
Seofian	-	600	1,600
Isfahan Slag Cement	-	-	7,000
TOTAL	6,500	14,200	35,600

Production, Import, Export and Consumption of Cement in Iran in tons/year According to the Foreign Trade Statistics of Iran and Research Centre for Industrial and Trade Development of the Ministry of Economy

Year	Production	Import Tariff No. 192A, B	Export Tariff No. 192A, B	Consumption
1338 (1959/60)	676800	43200	-	722000
1339 (1960/61)	797400	39900	200	837100
1340 (1961/62)	675300	45500	500	720300
1341 (1962/63)	667600	26400	800	693200
1342 (1963/64)	768600	12100	68000	712700
1343 (1964/65)	1074700	24300	99000	1000000
1344 (1965/66)	1401800	19800	129000	1292000
1345 (1966/67)	1404000	115500	92500	1427000
1346 (1967/68)	1586000	39800	55000	1570000
1347 (1968/69)	1903800	63200	56000	1911000
1348 (1969/70)	2340000	96500	48100	2388400
1349 (1970/71)	2699000	54500	97000	2656500

Forecast of Demand, Capacity, Production, Export and Import of Cement in Iran

			1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Domestic Consumption	1000	tons/year	3550	7800	13600	23600
Installed Capacity		tons/day	14200	35600	53000	83000
	1000	tons/year*	4400	11040	16430	25730
Export	1000	tons/year	150	300	600	1000
Import	1000	tons/year	100	-	-	-
Production	1000	tons/year	3600	8100	14200	24600

*Based on 310 working days per year.

The above given forecast of demand of cement has been made by the author of this study on the basis of the following assumptions:

(1) Covered area of buildings in sq.m. given in Code No. 400 - Construction of Building.

(2) Consumption of cement for sq. m. of covered area as follows:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)
New Private and Public Construction of Housing and City Buildings			
Kiln Bricks and Steel	60	66	77
Reinforced Concrete	122	130	140
Kiln Bricks and Wood	24	26	30
Prefabricated Elements	154	160	165
The Others	100	110	122
New Private Construction-Industry and Trade			
Kiln Bricks and Steel	70	77	85
Reinforced Concrete	160	165	170
Kiln Bricks and Wood	32	-	-
Prefabricated Elements	192	200	204
The Others	150	155	160
New Public Construction-Industry			
Kiln Bricks and Steel	160	166	170
Reinforced Concrete	210	220	225
Kiln Bricks and Wood	55	-	-
Prefabricated Elements	230	240	244
The Others	170	175	180

Domestic Consumption of Cement in tons:

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)
New Private and Public Construction of Housing and City Buildings:			
Kiln bricks and steel	989,460	1,766,620	2,144,879
Reinforced concrete	175,920	502,190	1,245,860
Kiln bricks and wood	54,290	53,330	92,580
Prefabricated elements	94,090	257,440	664,950
The other	213,700	280,060	398,820
New Private Construction - Industry and Trade:			
Kiln bricks and steel	131,880	261,730	490,870
Reinforced concrete	21,080	61,050	173,080
Kiln bricks and wood	3,010	-	-
Prefabricated elements	5,950	32,000	87,520
Others	14,100	18,140	33,440
New Public Construction - Industry			
Kiln bricks and steel	463,200	891,590	1,639,310
Reinforced concrete	41,370	172,920	423,680
Kiln bricks and wood	8,030	-	-
Prefabricated elements	14,720	76,800	209,600
Others	10,540	42,900	64,800
Subtotal	2,241,340	4,416,770	8,469,420
Maintenance and repairs of buildings, fencing, pavement etc., approximately 5% of subtotal	112,660	223,230	420,580
Agricultural activities (without irrigation)	100,000	280,000	480,000
Dams and irrigation	270,000	370,000	460,000
Cement consuming industry (concrete poles, sleepers, pipes, mosaik tiles etc.)	46,000	130,000	240,000
Increase in stocks	30,000	80,000	100,000
Communications, transport (roads, bridges, harbours, airfields, telecommunications), power, water, gas and oil distribution, defence etc.	750,000	2,300,000	3,430,000
	3,550,000	7,800,000	13,600,000

For comparison is given consumption of cement - kg per capita in different countries and in Iran (see below)

Consumption of Cement - kg. per Capita in Different Countries

	1960	1965	1970
U.S.A.	310	334	312
Japan	242	332	552
West Germany	468	601	640
France	314	460	571
Italy	323	401	617
Great Britain	258	316	306
Czechoslovakia	370	404	516
Soviet Union	212	314	392

Consumption of Cement in Iran - kg per Capita

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Consumption kg per capita	111	216	326	485

It is assumed that the growth rate of consumption of cement will be abnormally high in the construction of buildings, roads, harbours etc., but low (or negative) in the construction of dams and irrigation, as new dams will be mostly earthen ones.

An excess number of licences were issued during the Fifth Five-Year Plan and if all are implemented, overall plant utilization in 1350 (1977/8) will fall to 228 days per year. It is probable, however, that there will be delay in the construction of some plants during both the Fifth and Sixth Plans which could offset over-capacity.

The forecast of cement production for 1356 (1977/8) prepared by the Research Centre for Industrial and Trade Development of the Minitry of Economy, at 10,160,000 tons/year, is high, since most of the plants constructed during the Fifth Five-Year Plan will not reach full capacity, nor is the market demand expected to reach this figure.

Characteristics of Existing Machinery, Equipment and Processes:

Portland cements are produced by burning a mixture of calcareous and argillaceous materials to a clinker and then grinding it to a fine powder. Calcareous raw materials are limestone, cement rock, chalk, marble, oyster shells etc. Argillaceous raw materials are clay, slag, kaolin, fly ash etc.

The raw materials are processed into finished product in four stages:

1. Crushing - Different kinds of crushers are used - gyratory crushers, jaw crushers, roll crushers, hammer mills, impact mills etc.

2. Grinding - Two process are used:

2.1 The wet process - Raw materials are blended, mixed with water and ground in tube and compartment mills.

2.2 The dry process - Raw materials are dryed in cylindrical dryers and then ground to a fine powder in a compartment mill. The ground raw material is conveyed by pneumatic pumps and screw conveyors to concrete silos; raw materials are proportionally blended and homogenized.

The dry process is cheaper than the wet process having a lower unit fuel consumption and, more important in Iran, it requires less water. On the other hand it needs raw materials of uniform quality. It is expected that the dry process will be used more than wet process in the future.

3. Burning - The ground raw materials are transported to horizontal rotary kilns, vertical or shaft kilns are not used in Iran at present, and there changed by burning into clinker. Most rotary kilns are heated by fuel oil but in future natural gas may be used. Hot clinker from the rotary kiln passes to a clinker cooler, which reduces the temperature.

4. Finish Grinding - The clinker is ground with 4 - 6% of gypsum in the mills (ball mills, compartment mills and tube mills), to produce finfished cement which is transported pneumatically to silos. Cement is transported in paper bags or in bulk in specially designed trucks and railroad boxcars.

Code No. 339 Manufacture of Non-Metallic Mineral Products

Code No. 3391 Manufacture of Lime including Mining When Combined
Code No. 3392 Manufacture of Plaster including Mining When Combined
Code No. 3393 Manufacture of Reinforced Concrete Products
Code No. 3394 Manufacture of Concrete Products Without Metal Reincorcement Concrete Bricks, Blocks, Tiles, Mosaics etc.
Code No. 3395 Manufacture of Pipe and Sanitary Articles
Code No. 3396 Miscellaneous Manufacture of Plaster and Gypsum Products as Statues
Code No. 3397 Manufacture of Abrasives and Asbestos Products
Code No. 3398 Manufacture of Products from Graphite
Code No. 3399 Miscellaneous Non-metallic Mineral Products Manufacture

Code No. 3391 Lime Plants:

Lime (quick lime, calcium oxide) is produced from calcareous materials, generally limestone, chalk or dolomite, containing more than 94% of calcium carbonate. The main users of lime in Iran at present are the building and food industries, and small quantities are used in other industries and in agriculture.

Lime plants in Iran are mostly small units, located in rural areas, generally close to the mine in the vicinity of big towns, and there are no figures giving the number of these units and their total production. Only 31 lime and chalk units employ more than 10 workers, and all use old type chamber kilns. None are equipped with modern machinery and equipment such as vertical shaft kilns or horizontal rotary kilns. The biggest of these units is Zomordian Co. Teheran, with a production of 24000 tons in 1346 (1967).

Where modern lime plants with vertical shaft kilns exist they are associated with sugar plants for the production of calcium oxide and carbon dioxide. Only one lime plant associated with a sugar plant is equipped with a horizontal rotary kiln.

Lime produced in chamber kilns is of low quality, often not fully burned resulting in blooming on the walls of houses. Chamber kilns without any mechanization have a low investment, but the fuel and labour cost is high, and therefore it is probable that they will be gradually replaced by vertical shaft kilns or horizontal rotary kilns. From the figures for the total extraction of limestone in "organized" quarries (see Code No. 1990) it is possible to estimate the production of lime. Assuming that 95% of extracted limestone was converted to lime, the production of lime in 1347 (1968/9) was approximately 1,600,000 tons. Of this quantity, approximately 370,000 tons were produced and consumed in sugar factories, approximately 900,000 tons were used for building purposes and the remaining 370,000 tons were used for other purposes including agriculture, and the chemical industry etc.

There will be an increase in the consumption of lime for chemical and metallurgical purposes. Lime is used in the production of refractory materials, in the manufacture of open-hearth and electric-furnace steel, in the treatment of aluminium, in the manufacture of paper, and in calcium carbide etc. Lime will also be used as a soil-stabilizing agent in the construction of base courses for highways and airport runways. In the building industry, lime will lose its importance, being replaced by cement etc. In the USA, lime for masonry and finishing represents only 7% of the total consumption.

Forecast of Demand for Lime (in 1000 tons)

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Demand of Lime	2,600	5,250	7,600	9,800

Using 1347 (1968/9) as the base year and the historical annual rate of increase of production, figures for the years 1351 (1972/3) until 1366 (1987/8) were exterpolated, by the author of this study.

Per Capita Consumption of Lime in Different Countries in kg.

	1960	1965	1960
U.S.A.	41,5	56,0	-
West Germany	182,4	187,0	186,3
France	21,8	23,9	-
Japan	12,2	17,3	41,6
Soviet Union	75,3	76,7	88,7
Czechoslovakia	169,0	169,9	151,4

Forecast of Per Capita Consumption of Lime in Iran - in kg.

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Per Capita consumption in kg	97	168	181	202

Characteristics of Existing Machinery, Equipment and Processes:

As already mentioned, only lime plants integral with sugar plants are equipped with vertical shaft kilns and other modern machinery and equipment. All other plants have old chamber kilns without any other machinery and equipment. In future, these plants will be gradually replaced by new plants equipped with vertical shaft kilns or horizontal rotary kilns, fired by natural gas or crude oil. The first lime plant to be modernised is that of Ab Yek (Gache Teheran), which will commence operations in 1351 (1972) with a capacity of 1000 tons/day of lime.

Code No. 3392 - Plaster of Paris Plants:

Plaster of Paris, the hemihydrate of calcium sulphate $CaSO_4 . \frac{1}{2}H_2O$, is made by calcining the mineral, gypsum $CaSO_4 . 2H_2O$, (rock gypsum, gypsite, alabaster, satin spar, selemite) at a temperature 150-250°C. Gypsum is calcined in kettles or kilns to remove part of the water of crystallisation, to produce plaster of Paris.

The main user of plaster of Paris in Iran is the building industry but a small quantity is used in pottery, porcelain factories, and as a filler in paints and in paper.

[illegible] plants in Iran are mostly small units, located in [illegible] the mines and there are no figures giving the number of these [illegible] production. Based on the total extraction of gypsum [illegible] (see Table No. 1992) it is possible to estimate the production of plaster of Paris. Assuming the whole quantity of extracted gypsum [illegible] to plaster of Paris, the production of plaster of Paris in the year [illegible] is approximately 1,170,000 tons.

Two modern plants are planned to produce plaster of Paris in association with [illegible] plants. One will be in Teheran, and the other in Shiraz, [illegible] having a capacity of 1000 tons of plaster of Paris/day each.

Characteristics of Existing Machinery, Equipment and Processes

Existing small factories are using primitive kettles and kilns for the production of plaster of Paris. Modern units will be equipped with horizontal rotary kilns and mechanical handling equipment for handling, grinding etc. The first modern plant to be constructed is that of Teheran Gypsum Company, Teheran, having a daily capacity of 1200 tons of plaster of Paris, at which production started in November 1970.

In Iran, there are numerous deposits of high quality gypsum and therefore, in future, plaster of Paris could be used for the production of prefabricated elements for the building of houses such as plaster planks (precast roof deck units with steel frame work), plaster stones and partition walls (plaster mixed with different kinds of fibres - coir fibres etc. or mixed with slag). Attention should be given to this possibility of using new materials in the construction of houses.

Forecast of Production of Plaster of Paris

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production of plaster of Paris 1000 tons	1,750	2,850	4,350	5,100
Per capita consumption - kg.	56	78	104	105

The above given figures are based on past statistics projected forward on a time basis.

Code No. 3393 Manufacture of Reinforced Concrete Products including Poles, Girders, Railroad Sleepers etc.

Code No. 3394 Manufacture of Cement Bricks, Concrete Blocks, Tiles etc. (without reinforcement)

The Iranian building industry has developed rapidly during this last decade, and wages paid in the building trades have substantially increased. This has given rise to a search for new and unconventional materials and methods, and pre-fabricated elements made of plain concrete, reinforced concrete, pre-stressed concrete and light weight concrete are now used extensively. The introduction of factory production methods into building construction has raised the efficiency of the industry in industrial, trade and dwelling construction.

Plain concrete is a mixture of cement with water, sand, and gravel, or slag, clinker, pumice, crushed bricks etc. in different proportions according to the use of product. Since plain concrete has little tensile strength it is used in concrete structures and elements not subject to direct tension, bening, or impact stresses, including cement stones, concrete curbs, guardstones, slabs, roof tiles, hollow stones etc.

Reinforced concrete is used in structures and elements that are subject to forces producing tension. The reinforcing material used in concrete construction consists of hot rolled or cold drawn steel bars of round or special square cross section of smooth or profiled surface, wire mesh or expanded metal.

Pre-stressed Concrete - Pre-stressing of reinforced concrete is the application of external forces to create internal stresses of opposite direction to the critical atresses arising in service. A steel wire or rod is a tension carrying element. There are two principal methods of pre-stressing:

1) Pre-tensioning - the steel is pre-stressed before the concrete is cast.

2) Post-tensioning - the steel is stressed after the concrete has hardened.

The pre-stressing material is hard-drawn steel wire, of tensile strength not less than 100 kg/sq.mm, stress relieved wire (hard-drawn wire tempered to low temperature) and hot galvanized hard-drawn wire.

The chief advantage of pre-stressed concrete is a substantial reduction in the required quantities of concrete and steel. For example, the use of high strength pre-stressing steel reduces the steel requirements to one-sixth of that required for reinforced-concrete designs, and lighter concrete cross sections may be used. On the other hand, the cost of machinery and equipment and the cost of high strength pre-stressing steel is higher than that required for normal reinforced concrete designs.

Light-weight concretes are concretes weighing from 600 to 1600 kg/cu.m. To reduce the weight fillers are used including expanded clays, wood, cork, wood saw dust etc. These concretes have low compression strength but good thermal and sound insulation properties.

Pre-fabricated members made of plain or reinforced concrete are used for many products previously made of other raw materials, mainly wood. There is a large variety of these pre-fabricated members, and only a few of the more notable ones are mentioned here.

Fences - Pre-fabricated posts of different shapes, made of reinforced concrete are made in many shops in Iran but plates made of reinforced concrete are not yet produced.

Concrete guardstones, boundry marks and mileposts are made of plain concrete or low quality reinforced concrete. These pre-fabricated members are produced in Iran mostly in small shops along with pillars for fences.

Concrete curbs for bordering sidewalks etc. are made of plain concrete. They are produced in small shops with other plain concrete products such as pillars, guardstones etc.

Shaped concrete pieces for tunnels, drifts and shaft lining are made of plain concrete and are produced in small shops with other products.

Shaped concrete pieces for cable and wire ducts are made of plain concrete or of low quality reinforced concrete. They are shaped in steel moulds using vibrating hammers, or by pressing with mechanical or hydraulic presses.

Well and shaft linings are made of plain or reinforced concrete, either as one cylindrical piece, or of several segments. They are produced in small shops with other products such as concrete pipes etc.

Concrete pipes for water and sewage are made either from plain concrete, reinforced concrete, or pre-stressed concrete although the latter are not yet produced in Iran. The main requirement for concrete pipes is that they should be impermeable. Pipes made of plain concrete are used for water or sewage flowing in the pipe without pressure. They are made by hand, using pneumatic hammers to ram the concrete into steel moulds, or by vibrating and pressing on special presses.

The use of centrifugal casting with moulds rotating in the vertical position or vibrovacuating in special moulds is not yet done in Iran. Reinforced concrete pipes are made mostly by vibrating concrete into moulds or by centrifugal casting into vertical moulds although the method is not yet used in Iran. Pre-stressed concrete pipes are produced by the Tehran Water Board, at a plant capable of producing 24" to 80" diameter of pipes in 5-6 metres lengths, with a capacity of over 20 km per year of large diameter mains. Other bfg plants producing plain concrete pipes up to 1000 mm diameter and reinforced concrete pipes up to diamenter 3000 mm are Betonmack Co. Ghazvin and Karaj.

Prefabricated concrete piles are made of reinforced precast or prestressed precast concrete. They are used to carry bearing foundation pressures in low bearing capacity soils in the building industry, for underwater supports for piers, wharfs and for bridges. Pre-stressed, precast piles are either monolithic piles, prestressed by pre-tensioning, or piles made of sections, pre-stressed by post-tensioning. Pre-fabricated concrete piles are mostly produced and used on the shore of the Caspian Sea and the Persian Gulf.

Ceiling Panels are plate constructions, lightened by round hollows, made of prestressed concrete. The panels are made in widths from 40 cm to approximately 240 cm and in lengths up to 600 cm, and are designed for different loads. The production of ceiling panels started in Iran approximately 2 years ago. One of the firms producing ceiling panels is Prebeton Co.

Roof Panels are plate constructions made mostly of reinforced concrete, [illegible] hollows. The panels are made in widths 30 cm or more. Reinforced concrete roof panels are made on vibration tables. Roof panels made of prestressed concrete are made in long strips, using mostly pre-tensioned concrete.

Floor joists are made I-or T-shape beams, made of reinforced concrete of prestressed concrete designed for use with prefabricated ceiling blocks. In Iran, shaped bricks connected by reinforced concrete and having a supporting arc welded steel structure of high tensile steel bars is the most common design. The producer of these joists including hollow ceiling blocks made of fired clay is Italran Co. Teheran.

Floor blocks are hollow stones made of lightweight concrete such as slag concrete, tuff concrete, pumice concrete etc. or fired clay, hollow shaped bricks. Hollow bricks, produced in Iran by Italran Co. Teheran are frequently used. The thickness of blocks is 12 cm, 16 cm, 20 cm, 24 cm, 30 cm and 40 cm.

Prefabricated lintels - for example window, door, balcony and other lintels are made of reinforced concrete. They are hollow or solid, with or without a thermal insulation layer etc. Prefabricated lintels are used in Iran only rarely.

Prefabricated girders made of reinforced concrete or prestressed concrete are used as horizontal supports for ceiling and roofs. Prefabricated girders are used in Iran only occasionally.

Concrete floor and wall tiles are made of one or two layers of plain concrete. Where the floor or wall tile is made of two layers, the upper layer contains admixtures of crushed material such as travertine, marble, dolomite etc.

(terazzo). After the hardening the upper surface is ground. The dimensions of concrete floor and wall tiles are 20 x 20 cm up to 50 x 50 cm, and the thickness is 2, 5 up to 7 cm. There are many producers in Iran, since both floor and wall tiles are often used.

Window frame posts, cross beams and parapets are made of concrete or reinforced concrete. Window parapets are made of reinforced concrete with an upper layer of terazzo, but they are little used in Iran.

Prefabricated purlins are made of reinforced or prestressed concrete. Purlins are supporting elements for prefabricated roofs made of reinforced concrete. T-shape purlins similar to floor joists are produced by Italran Co. Teheran.

Panel Assembly Construction:

The prefabrication of concrete members presents the following advantages as compared to the classic methods of dwelling construction:

1) Shortening of construction time - erection only is undertaken on site and therefore a quick commissioning of the investment is obtained.

2) Saving of materials - timber usage on shuttering is radically reduçed, the structure weight is decreased, losses due to handling and transport are reduced and accurate proportioning of the concrete mix effects savings.

3) Saving of manual labour, especially on the construction site. Labour productivity is increased as the factory manufacturing processes are mechanized and higher productivityresults from improved technology.

4) Improved quality due to better control of production and the employment of more skilled staff.

5) Lowering of overall building costs - the design cost is lower due to standardisation of structural members, the equipment is fully utilized, and scheduling of the work is easier.

At present, prefabrication makes use of silicate based materials since they possess suitable physical properties and are relatively cheap. A combination of silicate based materials with new chemical building materials could have advantages.

Vertical elements (panels) are classified into two groups:

a) Load-bearing walls which carry part of the weight of the building and provide acoustic divisions between apartments.

b) Walls having no load-bearing function, which are manufactured from high quality thermal insulating materials of low density.

In Czechoslovakia, experience indicates that every sq. m. of utility area requires 0,4 cu. m. of prefabricated elements of all kinds. The majority of wall panels are designed in plain concrete, but an exception to this are panels with openings, with lintels and thin posts made of reinforced concrete. Outside cladding is formed by parapet panels of layer (sandwich) construction, supported by steel brackets. The construction of joints is simple, employing welding and pouring-in of concrete during the assembly operation. The inserting of reinforcement for grooves is not normally, although it may be useful for transversal stiffening of some products.

Another method of construction is the skeleton assembly system. The principle of the system is a frame joint of prefabricated beams placed between the head and the foot of the prefabricated columns with horizontal and vertical reinforcement. There are two variations of this system:

1. In the first method, members are so designed, to make it unnecessary to weld them together, but only to assemble them. For example, columns have a pin on one side and on the other a hole to mesh with the pin of the next column, and in this way site welding is completely avoided. Disadvantages are difficult

transportation during which pins and holes must be carefully protected, and difficult precise erection. The long-distance transport of pre-cast elements is possible only by means of special trailers. This system is used for example in France, Austria etc., where intensive erection is particularly advantageous.

2. In the second method the members are very simply constructed. The assembly is made monolithic by welding the joints and filling them with concrete. The assembly of continuous girders is effected in such a way, that the reinforcement protruding from the column of the lower floor passes through vertical assembly holes of the beam or of the floor slab and is welded to the reinforcement of the column of the upper floor. Similarly the assembly of the beams above the support is made by welding the exposed reinforcement. The bed joints between the girders and the columns are filled with a mortar layer, and an epoxy resin filler etc.

The horizontal floor structure is inserted between the columns. Thus the joining of the frame is arranged in the easier way, which results in maximum simplification of the shape of manufactured elements. The protruding reinforcement of the columns is, in a very simple way, threaded through the openings in the girder, which secures perfect assembly stability and security of the frame and enables an easy balance of the production and assembly tolerances without detriment to the joint.

The basic assembly elements of the system are the column and the girder, and the distance between the axes of the frames is from 3,0 to 6,0 meters or more depending on the span of the floor panel. The average weights of the elements differ according to the category of the floor structure, the elements of the residental-constructions being up to 1,5 tons, those for public buildings up to 2,5 tons and those for industrial constructions up to 5,0 tons. The elements of structures with hidden girders weigh from 2,5 to 3,5 tons and the slabs from 5 tons upwards.

The relatively low weight of the structure, the lower weights of individual elements, and easy transport are advantageous and the long distance transport of the pre-cast elements presents no problems. The skeleton structures are assembled by means of normal low-lift cranes from 4 to 8 tons capacity and hoisting radius of 20 - 25 m.

There is a lack of data about the present production of concrete components but according to the Ministry of Economy, Bureau of Statistics, the production of components and parts made of concrete are as follows:

		1346 (1967/8)	1347 (1968/9)
Cement pipes and blocks	1000 pcs.	5,480	4,853
	mil. Rials	170	148
Mosaik steps	1000 m	898	1,132
	mil. Rials	71	86
Concrete poles	pcs.	14,884	17,463
	mil. Rials	108	120
Concrete pipes for construction and water	tons	21,180	19,498
	mil. Rials	311	287

Forecast of Production of Concrete Pipes

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production tons	30600	61500	120000	180000

Using 1347 (1968/9) as the base year and the historical annual rate of increase of production, figures for the years 1351 (1972/3) and 1356 (1977/8) were exterpolated, by the Research Centre for Industrial and Trade Development of the Ministry of Economy, for the years 1361 (1982/3) and 1366 (1987/8) by the author of this study.

The high growth rate is due to the expected construction of sewerage systems in Teheran and other towns in the future.

Forecast of Production of Prefabricated Elements for Buildings (all types)

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Production	1000 cu.m.	175	515	1,270	2,400

The forecast was prepared by the author of this study and is based on ratio 0,25 - 0,28 cu.m. per 1 sq.m. of covered area of buildings made of prefabricated elements. - see Code No. 400 - Construction of Buildings.

Code No. 3396 - Miscellaneous Manufacture of Plaster and Gypsum Products

There are only small shops without machinery and equipment, producing statues etc. in Iran at present. It is assumed that in future plaster and gypsum will be used for the production of prefabricated elements (see Code No. 3393, 3394).

Code No. 3397 - Manufacture of Abrasives and Asbestoes Products

1. Abrasives:

An abrasive is hard material used to grind or polish less hard materials. There are two kinds of abrasives:

a) Natural abrasives of which some examples, in descending order of hardness, are diamonds, corundum, emery, garnet, quartz (quartz sand), sand-stone and pumice.

b) Synthetic abrasives - carborundum or silicon carbide (SiC), synthetic diamonds, boron carbide (B_4C) and artificial corundum (artificial aluminium oxide) (Al_2O_3).

Some natural abrasives are produced on a small scale in Iran at present, including quartz sand for making sandpaper and for sand-blasting, sandstone for making grindstones and sharpening stones, emery, pumice etc.

Synthetic abrasives from imported raw materials were produced by Ama Co. Teheran, but due to the low price of imported synthetic abrasives production has ceased in 1350 (1971). All synthetic abrasives and most natural abrasives are imported.

Import of Abrasives (tons) According to the Foreign Trade Statistics of Iran

Tariff No.		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1347 (1970/1)	1350 (1971/2)
633	Natural Grindstones, Polishing Stones	11,6	23,5	22,1	34,6	20,6	26,2
634	Natural and Synthetic Abrasives	431,0	501,8	500,1	525,5	529,7	595,9
635	Paper, Cardboard coated with Abrasives	181,2	164,0	221,0	306,8	350,7	323,5
636	Cloth coated with abrasives	74,6	75,9	87,7	126,1	130,3	129,4

Forecast of Consumption of Synthetic Abrasives (including Paper & Cloth) Tons

	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Consumption of Sunthetic Abrasives	1300	2800	5200	8300

The above given figures are based on past statistics (imports) projected forward on a time basis by the author of this study.

From the anticipated demand it appears that the production of silicon carbide, capacity approximately 2000 tons/year should be feasible during the Sixth Five-Year Plan, but the production of artificial corundum is not likely.

Description of Machinery, Equipment and Process:

Basic raw materials for the manufacture of silicon carbide are silicon sand and petroleum coke, anthracite and salt. The materials are fused in an electric resistance furnace and when cool the solid material is reduced in crushers and grinding mills. Feldspar, fireclay, kaolin and borax are used in the preparation of bonding material .

The ground silicon carbide is bonded together and shaped in hydraulic presses, then dried and vitrified in a tunnel kiln. The last operation is dressing of wheels on special machines.

2. Asbestos Products:

Asbestos is a generic name for a group of minerals which may be split into flexible fibres, spun and woven into special fabrics, which are resistant to heat, and incombustible. The most important minerals of this group are chrysotile, and serpentine-hydrous magnesium silicate - $Mg_3Si_2O_5(OH)_4$. Other fibrous minerals are, anthophyllite, amosite, crocidolite, tremolite - actinolite etc.

There is no factory producing asbestos yarn and fabric in Iran at present, and all asbestos fabrics are imported.

Import of Asbestos Fabrics - Tons, according to the Foreign Trade Statistics of Iran

Tariff No.		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
642A	Asbestos paper and cardboard	291,2	241,5	260,8	275,1	117,0	275,0
642B	Asbestos thread, cord	35,5	52,2	42,9	66,4	26,9	84,2
642C	Asbestos cloth	0,1	2,0	97,0	5,3	6,4	13,4
642D1	Asbestos garments	0,1	0,1	0,4	2,4	1,2	1,0
642D2	Asbestos footwear	0,1	-	0,1	3,6	-	7,0
642D3	Other asbestos manufactures	26,4	141,7	96,7	205,3	333,6	473,3

The production of asbestos fabrics requires long fibred minerals which are not mined in Iran. The demand for asbestos fabrics will remain low, and it is unlikely that asbestos fabrics will be produced in Iran and requirement will continue to be imported.

3. Asbestos-Cement Products:

Asbestos-cement products including pipes and fittings for sewerage system, tiles, sheets, corrugated sheets etc. are made of short asbestos fibre mixed with cement.

There are three factories producing asbestos cement products in Iran at present:

1) Iranit Co. Teheran, which has a capacity of 36000 tons/year of pipes and fittings and 48400 tons/year of sheets, tiles, corrugated sheets etc. Production statistics for this company are:-

		1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)
Pipes and fittings	tons	22869	22189	26447	27685
Sheets, tiles etc.	tons	10252	12322	14149	24539

2) Fars and Khuzestan Cement Co. (Farsit) - Dorood with a capacity of 30000 tons/year of pipes and fittings. Production started in the last month of 1348 (1970), and in the Fifth Five-Year Plan the production of pipes and fittings will be increased by an additional capacity of 36000 tons/year.

3) Cement Plant Looshan has a capacity of 30000 tons/year of pipes and fittings and 20000 tons/year fo sheets, corrugated sheets etc. The plant started production in 1351 (1972/3).

Imports of Asbestos- Cement Slabs and Pipes - According to the Foreign Trade Statistics of Iran

Tariff No.			1345 (1966/7)	1346 (1967/8)	1347 (1968/9)	1348 (1969/70)	1349 (1970/1)	1350 (1971/2)
641-1	Slabs	tons	23,0	81,7	33,4	31,4	28,8	54,9
641-2	Pipes & Fittings	"	982,3	130,8	271,4	-	50,5	14,3
641-3	Other Products	"	32,6	188,2	328,4	314,0	123,7	617,7

Forecast of Consumption, Capacity and Production of Asbestos - Cement Products

		1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Consumption	tons	70,000	140,000	255,000	420,000
Existing capacity	"	202,000	238,000	238,000	238,000
Extension of Capacity	"	-	-	100,000	200,000
Production	"	70,000	140,000	255,000	420,000

Using 1348 (1969/70) as the base year and the historical annual rate of increase of production of asbestos-cement products as well as growth rate of construction of buildings (See Code No. 400 - Construction of Buildings) figures for the years 1351 (1972/3) until 1366 (1987/8) were exterpolated by the author of this study.

Included in the consumption figures there is a small quantity for export, starting in 1356 (1977/8).

Description of Machinery, Equipment and Processes:

The asbestos mineral is ground in an edge runner mill and split into flexible fibres on a disintegrator. The fibres and cement are then transported to a hollander where both components are mixed with an excess quantity of water. The mixture is spread on a spreading machine in an even layer; the excess water is removed through the sieves of the machine, and the sheet is then shaped either to corrugated sheets, or spun on a special machine to pipes or fittings.

All three factories are equipped with modern semi-automatic or automatic machinery and equipment.

Break and Clutch Lining:

Break and clutch lining is mostly made of short-fibre asbestos bound by phenol formaldehyde resin. It is used mostly in the automobile industry and the mechanical engineering industry.

Only one company is producing break lining in Iran at present; Sherkate Sahami Lente Tormose Iran Teheran. The company is planning to expand production and will also produce clutch lining.

The factory has a capacity of 700 tons/year when working on a 12 hours shift; but at present production is 400 tons/year on a 10 hours shift.

The factory is equipped with modern machinery and equipment.

Code No. 3399 - Stone Cutting and Grinding

There are approximately 200 stone cutting and grinding factories in Iran, fully or partly mechanized, each having 10 or more workers and in addition many small shops with hand-operated or partly mechanised machines. The total number of workers employed in this industry is approximately 4500.

Stone Cutting and Grinding in Iranian Cities according to the Bureau of Statistics of the Ministry of Economy

	1344 (1965/6)	1345 (1966/7)	1346 (1967/8)	1347 (1968/9)
Stone cut and ground in 1000 sq. m.	1,913	2,050	2,512	2,449

Forecast of Production of Cut and Ground Stones

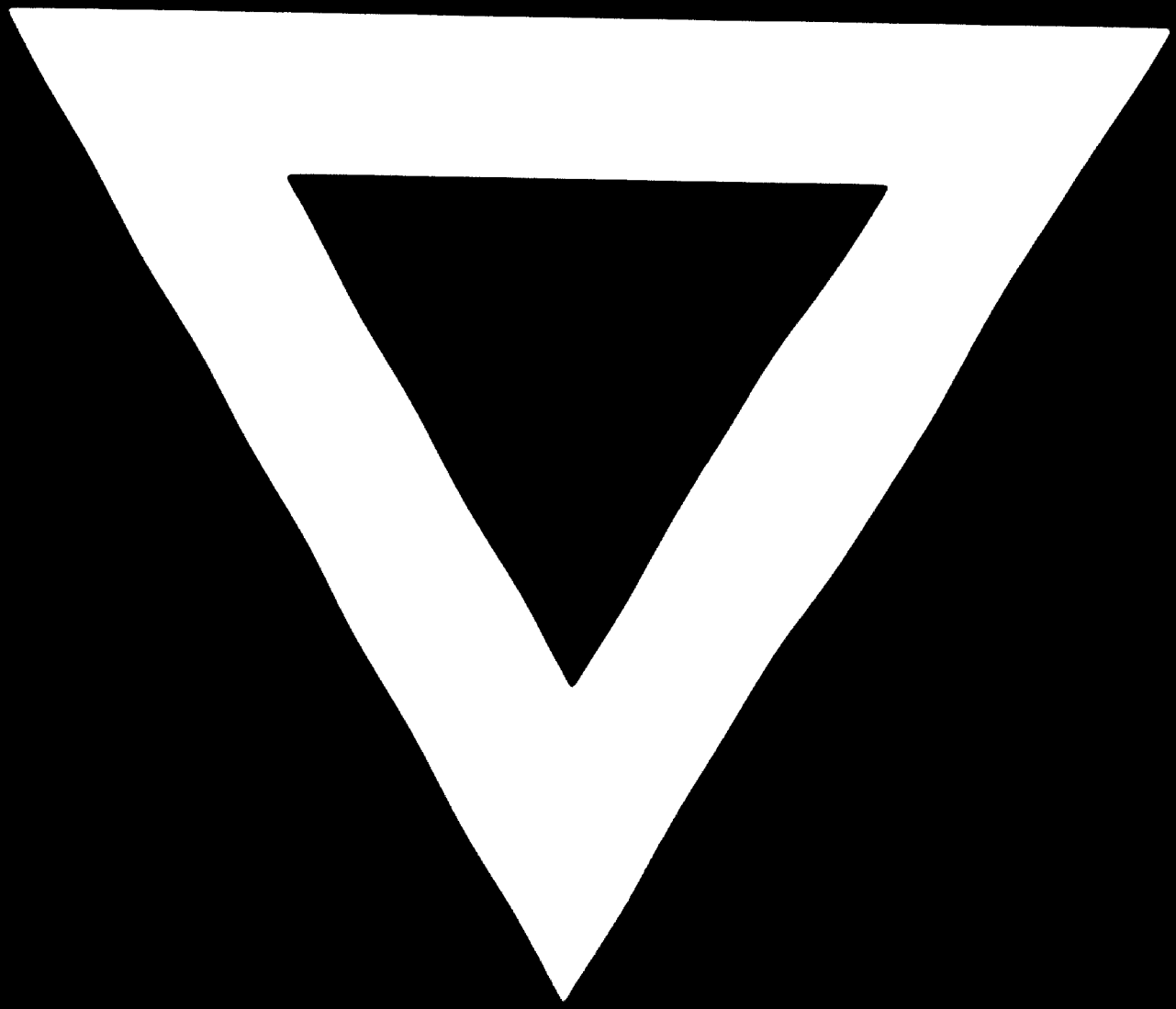
	1351 (1972/3)	1356 (1977/8)	1361 (1982/3)	1366 (1987/8)
Stone cut & ground in 1000 sq. m.	3,670	7,380	12,000	18,000

Using 1347 (1968/9) as the base year and the historical annual rate of increase of production of cut stone as well as growth rate of construction of buildings (See Code No. 400 - Construction of Buildings) figures for the years 1351 (1972/3) and 1356 (1977/8) were exterpolated by the Research Centre for Industrial and Trade Development of the Ministry of Economy and for the years 1361 (1982/3) and 1366 (1987/8) by the author of this study.

Description of Existing Machinery and Equipment:

The machinery and equipment in use is mostly old, some of which was produced in Iran. Stone blocks are transported by overhead cranes, pulley blocks or winches by means of platform carts to frame saws with one or more blades for stone cutting. Slabs are cut to rectangular shape using a rotating saw with a diamond blade. Approximately 80% of slabs are ground on radial arm polishing machines or by hand. Some factories are equipped with lathes for stone machining and polishing, for the production of vases, plates, etc. and with stone drilling machines.

Frame saws and polishing and grinding machines are produced in Iran, but the design is not modern and they are of low capacity.



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