THESIS

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A STUDY ON VARIOUS ASPECTS OF BRICK INDUSTRY IN ISTANBUL

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"Material of the past, yet one of the future: BRICK."
"Industries et Techniques,"
March, 1960

CHAPTER I

INTRODUCTION

Construction materials made of clayey soils have found various fields of application for thousands of years. Clay, a result of rock decay, is the most abundant of the materials used for the production of building materials. The main construction element made of clay is brick.

Up to the end of the nineteenth century bricks were produced in brick-yards. However, after the introduction of the brick-making machinery which makes possible the production of bricks of higher quality and more functional sizes and shapes, the brickyards gave place to modern factories.

All over Turkey the raw material for making bricks is abundant and historical evidence of brick production can be found in various parts of Anatolia. However, the development of modern brick industry in Turkey is very recent. Today, in many areas of Turkey, small brickyards work along side modern factories in the production of bricks though it is a generally accepted fact that it is uneconomical to operate small scale units in this field that could be highly industrialized.

Statement of the Problem

The topic of this thesis materialized from an interesting and baffling inconsistancy observed between the vast amount of construction activity in Istanbul and the poor quality of building materials supplied. As a general principle, the building materials industry runs parallel to construction activity, supplying better materials as the activity increases. However, even in Istanbul where the construction activity has almost tripled in the last ten years, the poor quality of building bricks used in many constructions is easily noticable. This paper contains a study of the present situation of brick industry in Istanbul and its efficiency in producing bricks for the best concern of the users and economy. The main topics of concern are: (1) The development of the modern brick industry as the demand for walling materials increases and the trend of changes in the shares of factories as compared to the shares of the brickyards. (2) A critical evaluation of the factors which affect the present distribution of supply of bricks and the general affects of the present distribution of supply to the economy.

The Scope of the Problem

The problem stated above is one of many facets. Its analysis requires a study of various parts of the system such as the products, producers, users and legal environment. Therefore it is a problem which involves an investigation of administrative and engineering aspects.

The analysis of the problem involves spotting defects in different parts and aspects of the system and investigating possible methods of improving the system to produce bricks at low cost and as required by the economy.

In a sense this is a regional study but in the region under study about 30 percent of the total system is concentrated and many aspects considered are to a great extent true for the general brick industry in Turkey.

The Istanbul area was chosen as the main center of consideration for several reasons: (1) Possibility of following a survey method within the available time. (2) Co-existance of several modern factories along with numerous brickyards. (3) The large scale of construction activities, for the production of bricks bear a direct relationship to construction activities. When referring to Istanbul area in this paper, the area from Kartal to Beykoz, from Sarıyer to Yeşilköy is included. These boundaries were chosen because it is within this area that bricks are supplied by factories and that many brickyards are located.

Significance of the Problem

The results of the first five year development plan show that in Turkey investment in building construction amounted to about 30 percent of the total investment (Table 1.1). In the 1965 statistics year book, where data are given for only registered housing constructions within the city municipality areas, it is shown that housing constructions in value make up for more than

60 percent of the total building construction investments. When the presence of unregistered buildings and the fact that the investment for housing constructions is almost always understated is considered, it can be said with confidence that investments in housing construction accounts for a greater part of the building construction industry which in turn accounts for a greater part of the total investment.

In Turkey the problem of housing is of great importance. Closely linked with this is the problem of building materials. Both of these problems are closely interrelated and the first problem cannot be solved without solving the latter. A planned material production policy would be one of the main steps to influence the housing construction in the desired direction. As things stand now all this is done in a haphazard manner in Turkey, and this causes a tremendous amount of waste for the Turkish economy.

Considering that for most buildings, materials account for about 70 percent[1] of the total cost of building constructions and that on the average 8.2 percent[2] of the material cost is taken by bricks, the significance of the brick industry for the Turkish economy becomes obvious. A 10 percent reduction in the cost of bricks would free about 50 million liras to be invested in more productive fields than housing construction.

In the second five year plan one of the main aims is to keep the

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[1]Turhan İskit, Yapı Malzemesi, Ayni ve Teknik Yardım (Ankara, 1962), p. 39.

[2]F. Kocataşkın, Yapı Malzemesi Bilimi (İstanbul, 1966), p. 5.

TABLE 1.1

Some Investment Figures in Turkey[1]

	years										
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Total investment in Turkey Billion T.L.	8.12	10.8	10.8	12.0	14.3	16.1	17.5	19.6	22.1	25.0	27.3
Investment in building const. in Turkey Billion T.L.	3.05	3.24	3.51	3.72	4.05	4.30					
Building const. inv. as % of total inv.	38.6%	30 %	32.5%	31 %	28.2%	27.7%					
Investment in housing construction in Turkey Billion T.L.	1.84	1.96	22.11	2.30	2.49	2.70	3.2	3.8	4.1	4.3	4.6
Investment in housing construction as % of building construction	60.1%	60.5%	60.1%	61.8%	61.5%	62.8%					

Source: Second five year development plan

[1]All investments are with 1965 prices.

steadily increasing housin g investments at 20 percent of the total investments. An organized materials research policy is of great importance which integrates the use of possible resources and reduces the total costs of housing constructions in order that this aim could be realized. The subject of development and rationalization of the brick industry is one of the important subjects that could help in attaining this aim.

However, the significance of brick industry indicated by the above discussion reflects only the initial amounts whereas the type and quality of bricks used in a building are closely related to running costs that last throughout the long useful life of the building thereby vastly increasing the estimated affects on the economy. The waste in heating costs as a result of using improper walling materials in Turkey reaches great sums and causes a waste in fuel resouces which could also be utilized in fields of greater productivity.

Methodology

In order to have a clear picture of the brick industry – which could be considered in two sections, one being the factories and the other being brickyards – and of the reasons for using bricks produced in brickyards, two surveys were designed.

In the first survey twenty brickyards, which were randomly chosen from sixty addresses given in a seminar report,[1] were visited. Information

[1]Tuğla-Kiremit Semineri, İmar İskan Bakanliği Yayınları, No. 5-20, 1964.

on production methods, capacities, sales prices, and types of bricks produced were obtained (Appendix 1). Along with the survey, samples of bricks from each brickyard visited were taken to be tested for quality. However, of the twenty brickyards visitied eleven had closed down for various reasons. Three others, found near the closed ones, were also included in the survey bringing the total number of brickyards from which information was obtained to twelve.

From each brickyard ten samples were taken by representative sampling. The bulk of bricks was divided into five convenient sections. Two bricks were taken from each section so that for each section of the bulk there would be a corresponding portion in the sample. These samples were later tested for compliance to standards in the materials laboratory of the Istanbul Technical University.

The same survey also included visiting three of the factories and receiving information on similar aspects. Here however, no samples were taken because test results were already available in the files of the materials laboratory. Having thus obtained data the producers and products a second survey was conducted to investigate some constructions as to the type of bricks used and the reasons for using that specific type of brick (Appendix 2). This survey covered only reinforced concrete buildings of various heights and areas. The choice of buildings under construction, however, was not made by random sampling. Here benefits to be derived from random sampling were sacrificed for the sake of convenience. Students were asked to obtain information on building constructions in process on the street they lived on.

If more than one construction was to be found they reported on the one that used solid hand bricks. This survey involved about sixty building constructions covering a total gross area of approximately 73,000 sq.m. Information was received on total areas, number of flats, reasons for use of certain types of bricks, quantities and unit costs.

Information was also gathered on two other products that are used as walling materials namely hollow concrete blocks and lightweight concrete blocks (YTONG). A wide variety of literature was examined, especially on construction activities, and standard specifications of some countries for bricks.

Using survey and research results, first the demand for total walling materials and the supply of substitute materials were estimated for the past ten years. From this information it was possible to estimate the demand for bricks for the same period. Knowing the total demand for bricks and using data obtained in the survey on factory supplies the share of hand bricks was estimated. A trend analysis was then conducted to estimate the future demand.

In the paper highly technical aspects of the subject which could be eliminated without introducing a significant error have been largely avoided.

CHAPTER II

BACKGROUND INFORMATION

A. A Brief History of the Brick Industry

Bricks are building units of dry or burned clay formed while plastic into rectangular prisms of various sizes. They are the oldest man-made structural materials and evidence of their use goes back at least 9000 years. They were first made and developed by the civilizations of the Middle East where timber and stone were scarce. Mud mixed with straw was filled into wooden moulds with open top and bottom. When the mud had hardened the moulds were removed and the blocks of mud were left to dry in the sun. Kiln baked bricks were also first made in Mesopotamia about 2400 B.C. "The domes of the Royal Tombs at the city of Ur testify the strength and architectural possibilities of the kiln baked bricks."[1]

The Aegean and Greek civilizations used very little brickwork since timber and stone were plentiful, however, the Romans achieved a high standard of brick-making.

Brick-making was introduced to Northern Europe during the Roman invasions. The fall of the Roman Empire ended the brick manufacturing in

[1] The New Caxton Encyclopedia (London, 1966), V. 3, p. 834.

Europe with the exception of the Byzantine Empire. In Europe the production of bricks was revived in Holland in the eleventh century. In most cities timber houses that had been destroyed in great fires were generally replaced by brick houses.

The popularity of bricks was further increased by the introduction of brick-making machinery in the 1850's which enabled the production of bricks at a low cost and of consistent quality.

It is interesting to note that the basic principles for manufacturing bricks have remained the same over thousands of years. However, scientific knowledge of the properties of the raw materials and of the effects of drying and burning processes on these has turned the manufacturing of bricks into a modern and up-to-date industry. With the discovery of portland cement and the advances in the construction techniques that followed it was believed that the use of bricks would be greatly reduced. However, the ease with which bricks can be produced to cope with the technical requirements as well as economic considerations has enabled bricks to maintain their place as an important structural unit. Following the invention of the brick-making machinery the introduction of bricks containing holes or cores running parallel to the sides of the unit has added a great deal of flexibility to the properties of bricks such as light-weight and improved thermal and acoustic properties.

B. Production Characteristics

The unit universally known as solid or common brick has been made in a variety of sizes. However, after the need for standardization and modular coordination was apparent, the sizes of bricks were fixed by various agencies in different countries.

The invention of modern machinery enabled producers to manufacture bricks containing holes or cores running parallel to either height or length dimension of bricks. With the introduction of these holes it became possible to manufacture bricks that could serve various purposes. The presence of holes in the brick though reducing compressive strength based on gross area also reduces the weight of the bricks and improves the thermal and acoustical properties of bricks. Therefore a wider scope in choosing the required walling materials is attained.

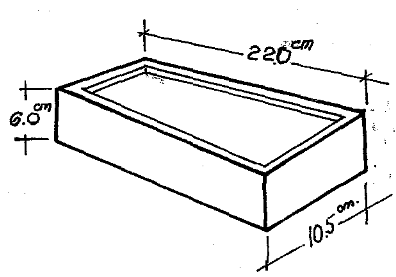

Fig. 2-1
Solid Brick

There are three main types of bricks classified according to the amount of void space and the direction of holes as laid in the structure.

Solid bricks are those with no holes. Perforated bricks are those which contain many small holes passing through, often in the direction of load applied (Figure 2.2).

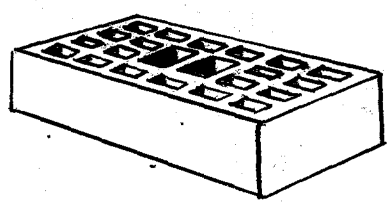

Figure 2-2
A Perforated brick

The third type of brick is hollow bricks.(sometimes called hollow clay blocks). In hollow bricks the holes are large and the volume of holes is greater than half of the total volume. They are laid so that the holes are horizontal.(Fig. 2.3)

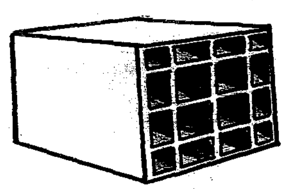

Figure 2-3
A Hollow brick

The advantages of brick as a building material are its strength, durability, ease of handling, its standard size and shape, insulation properties, and comparative lightness. All these advantages however are not equally distributed in all types of bricks. Depending upon the specific purpose of use some properties are sacrificed for others. The degree of sacrifice allowed in strength for other properties is often specified in standards. Solid bricks are strong but comparatively heavy and are not good thermal insulating materials. Perforated bricks are also strong. The aid provided by the holes in the burning process to obtain a more uniform product. This type often compensates for a smaller net area and is also lighter and a better thermal insulator.

Hollow bricks have low compressive strengths and therefore are often used in skeleton buildings as non load bearing walls. Their greatest advantage is lightness and high thermal insulation properties. Due to their low unit weight larger units could be handled and therefore they are time saving in constructing building walls. Table 2.1 shows some properties of various types of bricks manufactured in Turkey.

TABLE 2.1

Important Properties of Various Types and Some Sizes of Bricks

	EU	Weight Kg	Unit Weight Kg/L	Coefficient of Thermal Conductivity Kcal/mh°C
Solid bricks	1	2.4	1.7	70
Perforated bricks	1	1.5	1.1	34
	1.2	1.4	0.9	
Hollow bricks	4	4.0	0.74	32
	8	6.8	0.70	

EU: Denotes equivalent unit
Source: 1966-67 Türk Yapı Kataloğu

Hollow and perforated bricks are often larger than standard dimensions for solid bricks and are often referred to by the multiple units of solid bricks such as 4 equivalent units (4EU) or 8 equivalent units (8EU).

Due to the bulkiness of the bricks it is often found uneconomical to overhaul them long distances. It is also difficult to keep large stocks of bricks because of their bulkiness and the need for large closed spaces.

C. Standards

The existing standard specifications for various types of bricks and principles governing their sales was established in 1940 and printed in the official newspaper as brick standards.[1] In this standard bricks were classified mainly under five types and each type was further divided to first and second grades according to their average compressive strengths as shown in Table 2.2.

TABLE 2.2
Old Brick Standards

Types of Bricks		Minimum Average Compressive Strength Kg/sq.cm
I	Pressed bricks	150
II	Machine made bricks	
	First grade	100
	Second grade	80

(continued)

[1]"Resmi Gazete," 10/8/1940

Table 2.2 (Continued)

Types of Bricks		Minimum Average Compressive Strength Kg/sq.cm
III	Hand made bricks	
	First grade	60
	Second grade	40
IV	Perforated bricks	
	First grade	100
	Second grade	80
V	New type bricks	
	First grade	150
	Second grade	110

Some selected items of the standard are as follows:

Item 4: All types except type No. 5 shall have dimensions of 22x10.5x6 cm.

Item 5: The difference in any of the dimensions shall not exceed 4 percent of the standard dimensions.

Item 9: Compressive strength test shall be made by placing two halves (cut in a plane parallel to 10.5x6 cm sides) of the brick on each other and using cement mortar, of qualities, to unite and cap both ends of the specimen.

Item 13: Under no circumstances shall the percentage of broken bricks be greater than 3 percent for hand made bricks and 6 percent for other types at delivery.

Item 22: Bricks under all circumstances shall conform to the above specifications and those found not conforming are to be discarded.

Item 23: Bricks produced in or around towns or villages populated under 10,000 and used locally do not have to conform to the above standards.

The 1940 standards were prepared when the brick production in Turkey was almost completely carried on in brickyards. Therefore even the types of bricks are not well identified for the present existing products. Since 1962 new standards are being prepared and now it is in a tentative format. In the new standards the factory bricks and hand bricks are separated and various terms related to bricks are defined. The dimensions of solid bricks are changed to 240x115x52 mm.

There is no important change in the tolerances. For hand bricks 5 percent broken or defective units and for factory bricks 3 percent broken or defective units are allowed for. The main difference in the tentative standard is a change in compressive strengths and the addition of a minimum individual value.

The establishing of new standards is very useful for the brick industry, especially for redefining terms and requiring a certain homogeneity by indicating the lowest allowable individual compressive strength. However, this standard could still be heavily criticized from many aspects.

TABLE 2.3

New Brick Standards

	Average Comp. Strength Kg/sq.cm	Minimum Individual Compressive Strength Kg/sq.cm
Hand bricks		
First grade	60	45
Second grade	45	35
Factory bricks		
Solid or perforated		
First grade	200	160
Second grade	120	95
Third grade	80	65
Hollow bricks		
First grade	80	60
Second grade	40	30

1. The standards classify bricks as to their make and sizes; however, a very useful classification would be according to their allowable or recommended places of use since all the factors affecting quality are only meaningful if the conditions of use are specified. In Turkey solid bricks especially hand bricks are used as load bearing masonry units as well as non load bearing units; therefore, their compressive strength is important whether they are hand made or factory made. And since the construction of masonry is restricted to 3-5 flats all around Turkey, such a great difference allowed for the two types to be used in similar conditions is not reasonable.

2. Another point of the same nature is reflected when hollow bricks are considered. Hollow bricks are almost always used under conditions where there are no super imposed loads. Their main advantage is that of thermal insulation and light weight, whereas the compressive strengths specified for hollow bricks for first grade is greater than that of hand bricks and almost equal to third grade perforated bricks which are used under superimposed loads. An analysis of British, American, and German standards reveal the following. British standards classify bricks into three types: internal quality, ordinary quality, and special quality. Solid bricks and hollow bricks of ordinary and special quality are allowed to have a minimum average strength of 53 kg/sq.cm and 28 kg/sq.cm respectively unless a greater strength is agreed upon by the producer and user.[1] For hollow bricks to be used in internal walls of skeleton buildings a minimum average strength of 14 kg/sq.cm is allowed for.

American standards for structural clay non load bearing bricks do not even specify a minimum average strength.[2] It is considered that if other required aspects such as sizes and unit weight are

[1] "Specifications for Bricks and Blocks of Fired Brick Earth, Clay or Shale," British Standards Institution, BS 3921: 1965.

[2] "ASTM Standards, 1964," American Society for Testing and Materials, Volume 12, No. C 62-62, C 34-62, C 56-62.

TABLE 2.4

Standard Specifications for Compressive Strength of Various Types of Bricks in Some Countries Kg/sq. cm (based on gross area)

	Turkey TS				England BS	U.S.A. ASTM		Germany DIN	
	Brick yard		Factory						
Grade	A	I	A	I	A	A	I	A	I
Solid Bricks									
I	60	45	200	160	53	215	178	250	200
II	45	35	120	95		178	155	150	120
III			80	65		105	88	100	80
Perforated Bricks									
I			200	160	53	100	70	250	200
II			120	95		70	50	150	120
III			80	65				100	80
Hollow Bricks									
I			80	60	28 (LB)				100 (LB)
II			40	30	14 (NLB)				50 (LB)

A - Minimum allowable average strength

I - Minimum allowable individual sample strength

(LB) - Load bearing

(NLB) - Non load bearing

complied with the strength requirement would be fulfilled.

Table 2.4 which gathers together all the compressive strength requirements of the standards of four countries is given for reasons of comparison.

Another point of interest in this respect is a comparison of the Turkish standards on hollow concrete blocks which again does not specify the places of use but classifies the blocks as follows, according to their compressive strengths:[1]

	Compressive Strenghts based on gross area Kg/sq.cm.
High strength blocks	125 - 100
Normal strength "	75 - 50
Low strength "	25

Here it can be seen that 25 kg/sq.cm strength can be used for the same purposes as first or second grade hollow bricks which is believed to cause an inconsistancy.

3. The change in the sizes of solid bricks do not seem to be worth while. The difference is small, but it still requires a change in wooden molds for the brickyards and the problem will be complicated immensely when some brickyards follow the new standards while others refuse to or delay doing so. Increasing

[1] Türk Standartlar Enstitüsü, TS 406, 22/4/1966

the length and reducing the thickness does not seem to be well planned since hand bricks already seem not to cope with the specified lengths in existing standards (p.). Reducing the thickness would also cause a greater number of broken or defective units.

4. In the new standard there is no mention of changing Item 23 of the old standard. The control of this item is almost impossible since it does not prohibit production of bricks of very low quality near the cities or towns but allows only its use locally. It is to some extent possible to control bricks produced, but highly impractical to determine the production site or quality while they are being transported or on the construction site.

CHAPTER III

BRICK INDUSTRY IN TURKEY

A. General

A study carried on by The Union of Chambers of Commerce in 1958[1], to investigate possible investment fields in Turkey, on the brick and tile industry shows that in 1955 there existed 78 brick and tile factories in various parts of Turkey, and the production of these factories amounted to 102 million tiles and 50 million bricks. However, when it is considered that about fifteen times as many units of bricks[2] are required in constructions, it becomes clear that in 1955 the so-called brick and tile factories had completely concentrated on tile production and brick production was carried on mainly in brickyards. Though it utilizes the same materials and processes as the brick production, the production of tiles requires machinery, so it is therefore carried on only in the factories, not in the brickyards. Since 1958 through the establishment of new factories greater emphasis has been placed on the production of bricks in the factories. A comparison of the factory locations given in "Türkiye Sanayi Rehberi, 1967" and that of the study of the Chambers

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[1] "The Brick, Tile and Ceramic Industry," Union of Chambers of Commerce, 1958, Ankara.

[2] Figure found by dividing the total demand for bricks by the total demand for tiles given.

of Commerce in 1955 shows that in the last twelve years 41 new brick and tile factories have been founded in various parts of Turkey. However, no figures are available showing the production or the capacity of the factories established. Though many new factories are established in the last twelve years bricks produced in brickyards still meet the bulk of the demand in most cities and towns. According to a reference hand bricks meet 80 percent of the total demand in Turkey.[1] Except for the largest cities there are very few substitutes for bricks as a walling unit. However, in villages that are not in close vicinity of large towns and cities adobe is the most commonly used walling material.

B. Supply and Demand in Turkey

Since bricks are manufactured in numerous brickyards as well as in factories and since it is difficult to control these small producers, it becomes extremely difficult to estimate the total brick production in Turkey. However, since there are no uncompleted buildings due to a lack of brick supply and no possible way of having great stocks it can be assumed that supply is equal to demand.

It was first intended to make use of the statistics on total demand estimates in Turkey and then make an estimate of the demand in the Istanbul

[1] Mahmut Atalar, Türk Tuğla Standartları Hk., Türkiye Mühendislik Haberleri, Nov. 1967, p. 24.

area, utilizing the construction activity as a comparison base since the demand for bricks is a function of the construction activities. The first difficulty encountered here was the great difference in character of the buildings in Istanbul compared to the overall building construction in Turkey. This is reflected in Table 3.1.

TABLE 3.1*

A Comparison between the Characters of
Constructions in Istanbul and Turkey

Years	% of Reinforced Concrete to Total in Turkey	% of Reinforced Buildings to total in Istanbul	% of Const. units in Istanbul to total	% of investment in Istanbul to total
1958	9.7	---	3.9	21.3
1959	10.6	---	3.9	17.9
1960	6.0	---	4.9	21.6
1961	4.5	---	7.2	27.7
1962	6.8	77	7.5	30.4
1963	10.3	80	7.6	27.4
1964	10.6	82	8.2	25.4
1965	9.6	83	8.5	24.5
1966	---	85	8.8	23.4
1967	---	86	6.7**	23.4

*figures derived from 1965 Statistics Yearbook, pp. 14, 16

**for the first seven months

Now having established the difference in types and character of the buildings with certain assumptions the demand in Istanbul could be estimated with some accuracy. However, the next difficulty encountered was more serious which was the reliability of estimates for Turkey.

In a seminar held in 1962 in the Ministry of Reconstruction and Resettlement the demand for bricks in 1963 and 1982 was estimated respectively as 1.7 and 6.75 billion units. However, there is no mention of the method followed in order to arrive at these figures. The same figures are given in 1967 Türkiye Sanayi Rehberi. It is interesting to note that no modification of the estimation has been made in the elapsing five years.

"No figures are available showing the quantity of bricks manufactured. However according to the calculations made by the Ministry of Reconstruction and Resettlement, the estimated figures for 1962 and 1963 are 1.36 and 1.70 billion pieces respectively. The fact that no building project has been delayed too long because of unavailability of bricks and that no surplus exists should lead us to conclude that production is equal to the quantities cited above.

"Granting that the far-reaching housing projects which the government is contemplating to undertake with a view of providing homes for citizens with a low income, housing the growing population and alleviating the housing shortage in the cities caused by the mass migration from villages to cities, will develop rapidly, it can be assumed that in 1982 the demand for bricks will rise to 6.75 billion pieces."[1]

If this estimated demand is to be met by establishing new factories, it would correspond to 10 new factories each year with a capacity of 30 million units each. (The average capacity of the largest ten existing factories in

[1] Türkiye Sanayi Rehberi, 1967, M. 331

Turkey now is 17 million units.)

The above estimate of demand for Turkey is vulnerable from many aspects. One main aspect is the negligence to consider adobe which is a common substitute for bricks in all small towns and villages. Another is the increasing use of hollow concrete blocks and lightweight blocks for walling materials in the larger cities of Turkey to where the mass migration is considered.

Another source in which an estimate of demand is given for Turkey is the second five-year development plan.[1] Here the demand was accepted as 817 million units for 1962; 1430 million units for 1967 and it was estimated that in 1972 the demand would be 1960 million units (Graph 3.1). This estimate, though not acknowledging the quantity, takes the use of substitute materials into consideration. It is also interesting to note a third reference to this subject.[2] In a study sponsored by the Ministry of Reconstruction and Resettlement to estimate the supply of materials required for the planned social housing project it is estimated that an annual demand of 1,605 million units would be created and the demand for bricks to cover the total housing construction would be 3,387 millions. This estimate is projected on Graph 3.1, assuming that the demand for housing requirements is 80 percent of total de-

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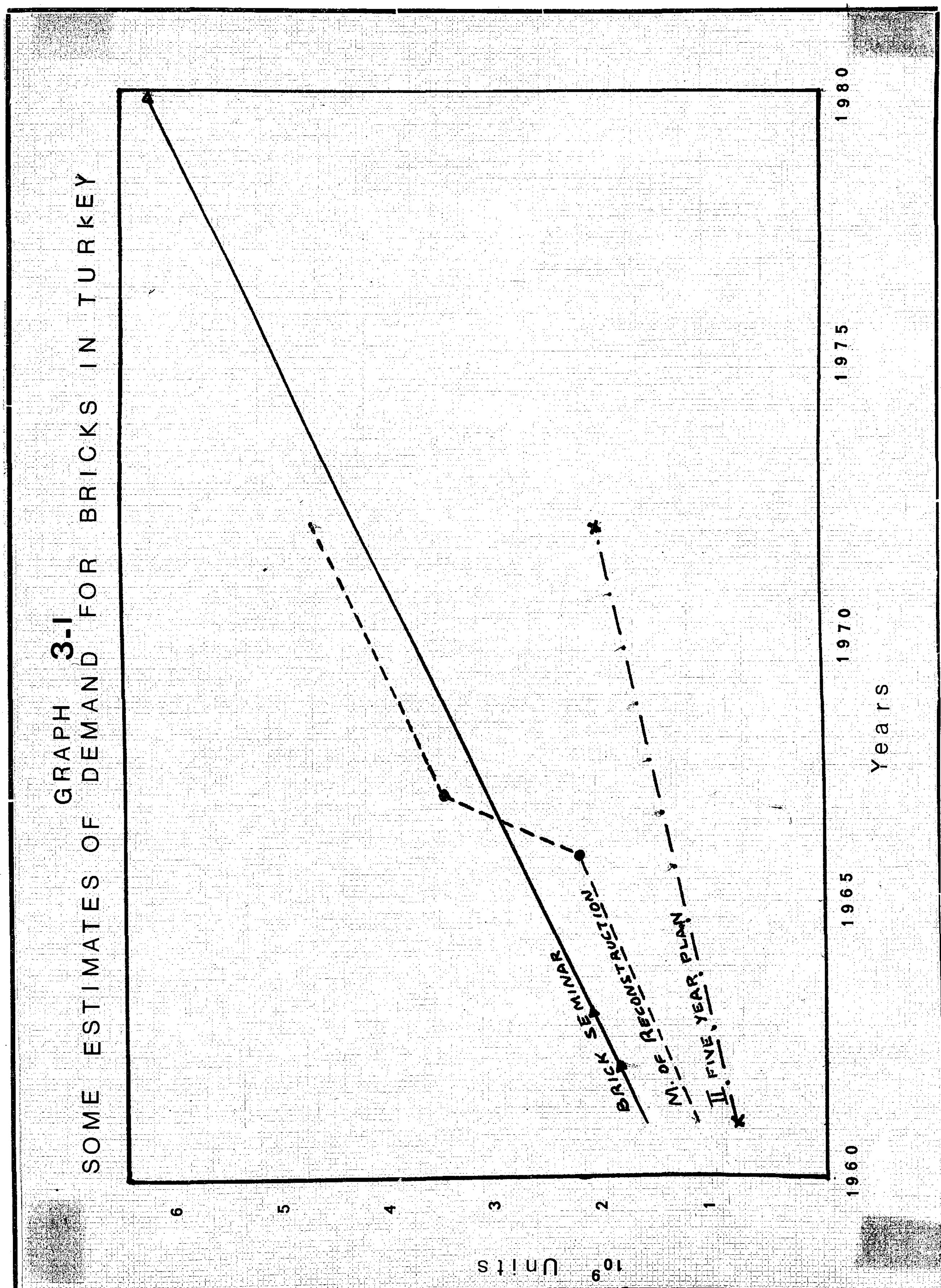
[1] Kalkınma Planı: İkinci Beş Yıl (Başbakanlık Devlet Planlama, 1967) p. 463.

[2] İskit, Turhan, Yapı Malzemesi - Ayni ve Teknik Yardım, (Ankara, 1962), p. 32.

mand and the total demand would increase at a rate of 8 percent annually.

The great differences between the above discussed three estimates (projected in Graph 1), though all are made in close circles, show a need for an analysis basing on more reliable data. It is believed that to be meaningful any estimate of demand for bricks must be prepared within smaller regions, considering substitute materials available in that region rather than considering Turkey as a whole and bearing estimations on general statistics for the whole country.



GRAPH 3-I

SOME ESTIMATES OF DEMAND FOR BRICKS IN TURKEY

CHAPTER IV

BRICK INUSTRY IN ISTANBUL

A. General

There is a vast activity of construction in Istanbul, especially in the field of housing constructions. Statistics indicate that housing construction activity has more than tripled in the last ten years and the investment in housing projects in Istanbul has been, on the average, 28 percent of the total housing investment in Turkey, for the last ten years (See Table 4.1).

TABLE 4.1

Housing Investments in Turkey and in Istanbul

Year	Total Investment in housing in Turkey Billion T.L.	Investment in Housing in Istanbul Billion T.L.	Housing Investment in Istanbul as % of Total	Total Const. Investment in Istanbul Billion T.L.	% of housing Investment in Istanbul to total const. inv. in Istanbul
1959	1.05	0.21	20 %	0.28	75 %
1960	1.17	0.28	24	0.34	82
1961	1.25	0.37	30	0.44	84
1962	1.52	0.53	35	0.61	87
1963	1.53	0.49	32	0.55	89

(Continued)

TABLE 4.1 (Continued)

Year	Total Investment in housing in Turkey Billion T.L.	Investment in Housing in Istanbul Billion T.L.	Housing Investment in Istanbul as % of Total	Total Const. Investment in Istanbul Billion T.L.	% of housing Investment in Istanbul to total const. inv. in Istanbul
1964	1.57	0.46	29 %	0.57	81 %
1965	2.09	0.58	28	0.69	84
1966	2.35	0.68	29	0.85	80
1967*	2.65	0.77	29	0.90	85

* Figures estimated from a comparison of the first seven months of 1966 and 1967. Monthly Bulletin of Statistics, August 1967, Başbakanlık Devlet İstatistic Enstitüsü.

Source: 1965 statistics handbook

It could be concluded that, parallel to the construction activity, the demand for walling materials has also almost tripled in Istanbul in the period mentioned above. The increased demand for walling materials has been met by the establishment of some modern brick and tile factories, small scale hollow block producers and one lightweight concrete block factory (YTONG), as well as an increase in the number and production of the numerous brick-yards.

In dealing with the brick industry, it is necessary to make a distinction, however, between the brick and tile factories and the brickyards, since the production methods and qualities and uses of the products differ widely. Therefore, the two will be considered separately.

There are no references, but one, available showing the development of the brick industry in Istanbul. Therefore, the following information has been gathered as a result of interviews conducted with the managers of brick and tile factories. The sole reference is for the year 1955:[1]

No. of bricks	No. of Workers	Capital in T.L.
19 980 000	857	13 377 336

Up to 1953 only one of the now existing seven factories was in operation in Istanbul, namely ASLAN brick and tile factory producing only solid bricks. Most of the demand for bricks was met by the brickyards scattered around the city. In 1953 KURT, in 1956 TOPSER, in 1960 TOPEL, and in 1961 VEZIROGLU brick and tile factories, which existed for some time as more developed brickyards expanded into factories.

The smallest of these factories now has an annual capacity of 10 million equivalent brick units, whereas the largest has a capacity of 50 million units, with a total of 153-176 million equivalent units of capacity. However, all of these use part of their production, which is almost up to capacity, for the production of roof and floor tiles (See Table 4.2). Therefore, the total factory produced bricks supplied to the market could be estimated as 135 million equivalent units.

[1] The Brick, Tile and Ceramic Industry, Union of Chambers of Commerce, Ankara, 1958.

TABLE 4.2

Brick Factories in Istanbul

Factories	Location	Capacity	Year Founded	Production of other Products
ASLAN	Kağıthane	15-20	1920	10 %
KURT	Pendik	15	1953	30
TOPSER	Büyükdere	50	1956	30
TOPEL	Kağıthane	40-48	1960	20
VEZİROGLU		18	1961	10
PAŞABAHÇE	Paşabahçe	10-15	1965	10
KÜÇÜKSU	Küçüksu	10-15	1965	10

Brickyards

Brickyards are scattered all around the outskirts of the city, the main areas of concentration being the Eyüp, Rami, Bakırköy, Kağıthane, Büyükdere, Üsküdar, and Pendik districts where the soil is suitable for brick production. These locations are often changed depending upon the concentration of construction activity and exhaustion of suitable clay deposits. A change in location is not difficult since most of the brick yards do not require any fixed investment. Also, due to the fact that the city expands towards the outskirts, some of the brick yards have been expropriated. The total number of these brickyards, as well as their locations, is not known since many of them are not registered. In a seminar held on the brick and tile industry in

Turkey[1] the locations of 60 brickyards were given for the Istanbul area. In the same seminar report, the number of addresses given for Ankara 99 and for Izmir is 79. Since there is not a great difference in the production of these brickyards and the construction activity is much greater in Istanbul than the other cities, it is obvious that the number of brickyards given in the report greatly underestimates the total number of existing brickyards in Istanbul.

A survey based on the given locations was designed in order to determine production methods and sales of the brickyards, as well as the prices and the quality of bricks produced. Of the 60 addresses given, 20 were chosen at random and these brickyards were visited. Only nine of the twenty brickyards visited had remained in operation at the given addresses, while the others were either closed for various reasons or had moved to other districts. In addition to the nine brickyards that were found at the given addresses, three new yards were located near the addresses of the closed yards were visited and samples of bricks were obtained from them, bringing the total number of yards visited to twelve.

Table 4.3 shows the location, reasons and dates of stopping operations of the closed yards.

Survey results show that of the twelve brickyards from which information was obtained, the sales of the smallest is 500,000 and of the largest

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[1] Tuğla-Kiremit Semineri (İmar ve İskân Bakanlığı Yayınları: No. 5-20, 1964).

TABLE 4.3

Brickyards from Where Information Could Not Be Received

No	Location	Date Closed	Reason for Closing Down
2	Eyüp	1965	Death of the owner
3	Yenikapı	1965	Expropriation
10	Kağıthane	--	Address not found
15	Kağıthane	1962	Expropriation
31	Şişli	1965	Health reasons of the owner
35	Kağıthane	1965	--
36	Şişli	1965	--
46	Üsküdar	1962	--
49	Maslak	--	Expropriation
50	Şişli	--	Address not found
59	Üsküdar	1964	Expropriation
60	Eyüp	--	Address not found

TABLE 4.4

Survey Results on Brickyards

No.	Location	Sales (units)	Years of Service	Price krş.	Fuel Type	Forming
4	Üsküdar	900,000	45	15.5	L	W
13	Eyüp	1,750,000	11	10.5	L	W
18	Bakırköy	500,000	16	10.0	L	W
19	Ayazağa	800,000	3	14.0	L or wood	W
23	Üsküdar	750,000	15	12.0	L	W
29	Eyüp	1,500,000	85-90	16.0	L	W
25	Bakırköy	900,000	10	15.0	L	W
45	Eyüp	1,800,000	30	13.0	L	W
47	Ayazağa	1,250,000	5	12.0	L	W
53	Üsküdar	2,000,000	3	13.0	L	W
55	Maslak	750,000	8	10.5	L	W
57	Unkapanı	1,100,000	9	13.0	L	W

L - lignite

W - wooden molds

is 2,000,000 bricks with an average of 1,070,000 and a standard deviation of 520,000 units.(See Table 4.4). The workers in these brickyards are unskilled and thus easily obtained. They come and go as production demands. In the brickyards there is no such word as capacity, it was found, for as orders are received workers are hired and supplies produced to meet the order.

B. Manufacturing Processes of Bricks

All the properties of bricks are affected both by the composition of the raw material and the manufacturing processes. The following summary of the manufacturing process is a result of surveys and interviews conducted in factories and brickyards with the intention of observing the differences in production of factory bricks and hand bricks, and spotting the defects involved in the production of hand bricks.

Factories

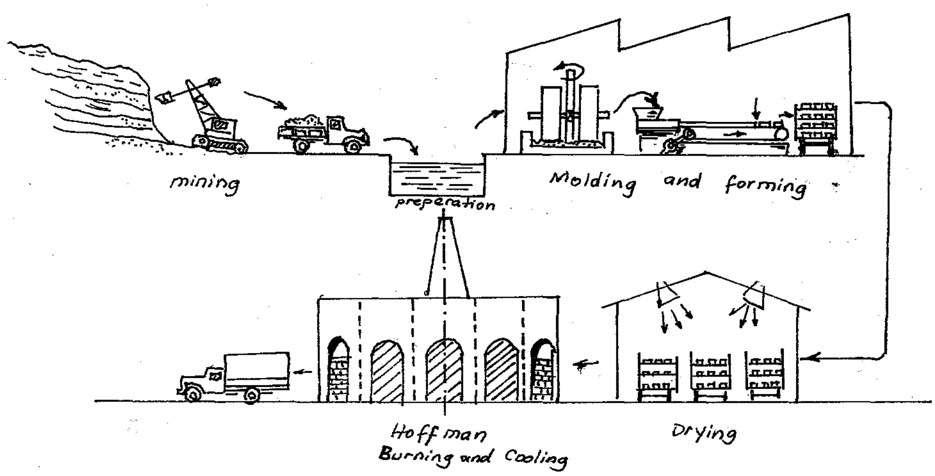
In all the factories visited a relatively modern manufacturing process is followed which consists basically of six phases:

1. Mining of raw material, i.e., clay.
2. Preparation of clay
3. Molding (forming units)
4. Drying

5. Burning

6. Cooling

FIGURE 4.1



PRODUCTION OF BRICKS IN FACTORIES[a]

[a]Source: Ferruh Kocataşkın, Yapı Malzemesi Birimi (İstanbul, Arı Kitabevi Matbaası, 1966), p. 21 Fig. 4

1. Clay is mined from open pits and transported to storage bins by various types of vehicles. Then the clay is blended to minimize variations. Blending is usually done during the storage phase.

2. Preparation of clay: The material is taken from storage to a crusher where larger pieces are broken and the stones are removed. Then, the clay is subjected to fine crushing or grinding operation where it is granulated to the desired fineness. At this point the material is ready for tempering in a pug mill where revolving blades mix the clay with water to bring it to the desired plasticity.

3. Molding: In the molding process the clay from the pug mill is

forced through a die by means of an auger, producing a continuous column of clay of the desired size and shape. The clay column passes through an automatic cutter which cuts off units of the proper length.

4. Drying: In order to reduce the moisture content to that desired for burning the clay is further dried after the molding process. This is done in a drying chamber which reduces the moisture content to about 3 percent. Drying causes shrinkage which must be allowed for when the bricks are being formed so that the finished product will be the proper size.

5. Burning: The dried product is then entered into a kiln. There are different types of kilns, but the sequence of burning is very similar in all. The degree of burning is dependent on the difference in raw materials, but this range varies between 900° to 1200° C.

Burning is a very important step in the manufacture of brick, because the mechanical and physical properties of the end product depends a great deal on burning. Rapid heating causes cracking and too slow heating produces a scum on the surface of the product if alkali exists in the clay or if much sulphur is present in the coal used in the kiln.

6. Cooling: After burning is completed a period of 2 to 3 days is required for cooling. Cooling must also be controlled because fast cooling will cause cracks in the brick.

Brickyards

The manufacturing process of bricks in the brickyards follows the same six phases explained. However, the phases are not well defined and the methods applied have not been improved for hundreds of years.

All the brickyards observed use man power in mining the material. The clay goes through almost no preparation except the removal of stones. The mixing of clay and water is done by shovels and the state of plasticity and homogeneity of the mixture is controlled only by observation. The mix is then placed in wooden molds and left to dry in the open. The process up to this point is common in all the brickyards, except some molds are sanded before placing the mix and are called sand-stuck bricks; whereas others are wetted and called water-struck bricks. In the burning phase, however, there are some variations. The most common method followed is to pile up bricks which are unmolded in such a way that under each row of bricks a layer of lignite is spread. The pile thus formed would be a few meters high. The outside of the structure, often dome-like, is paved with mud, leaving some openings in the bottom in order to set the lignite or wood on fire. The lot then continues smouldering for about a week during which time the bricks are fired. A great disadvantage of the method is that, since the heat cannot be regulated, some bricks are over fired while others are underfired. Since the molded clay shrinks in burning, those which are overfired show a greater shrinkage; therefore, uniformity of size is not maintained. But the effects of underfiring on the physical and mechanical properties of the bricks are even more serious, for the strength of the brick is greatly reduced.

Another method observed in two of the twelve brickyards observed is a more developed version of the method described above, in which the bricks are regularly on air circulating holes and burning lignite in a neighbouring chamber from which heat is regulated through the bricks and leaves the chamber through the air openings. This method is adjustable to required temperatures and allows for a more uniform firing. Therefore a product more homogeneous in properties and sizes is obtained. (However, due to the greater loss of heat from the kiln it is a more expensive method. It also requires an investment in the kiln.

None of the brickyards observed had any facilities for drying or storing the product. The cooling phase takes place in the paved dome and if enough time is allowed no harm is caused. However, if not enough time is allowed and the bricks are exposed before cooling, cracking occurs in the bricks. Due to the lack of facilities for drying or storing the product, the production is mainly confined to summer months. Production often starts in April and lasts till October. Even in summer months storing bricks in the open may be harmful since moist units when used in a wall, the shrinkage being restrained, could result in cracking of the plaster as well as the units themselves.

As could be observed from the above investigation, the main defects involved in the production of hand bricks are a result of uncontrolled choice of raw materials and the inefficiency of burning methods.

C. Estimation of Present and Future Demand for Bricks in Istanbul

In agreement with the argument given in Chapter III, the demand for bricks in the Istanbul area will be estimated in the following manner:

The demand for total walling materials in equivalent units of bricks will be estimated considering the total construction area in Istanbul and the structural types of buildings.

The production of substitute materials - hollow concrete blocks and lightweight concrete blocks (YTONG) - which could be estimated as described below, will be calculated and the difference between the demand for total walling materials and the supply of substitute materials will be assumed to be the demand for bricks.

In using this method of estimating the demand for bricks, it is assumed that the supply of subtitute materials is equal to their sales. However, this assumption is very nearly correct since hollow concrete blocks are almost always produced to order and no record of accumulation exists for these materials. And for both of the substitute materials much accumulation is highly improbable since immense covered space would be required.

Under the above assumptions the demand for bricks could be shown as:

$$D = D_W - (S_s' + S_s'')$$

where D = demand for bricks in equivalent units of bricks

D_W = demand for walling materials (EU)

S_s' = supply of hollow concrete blocks (EU)

S_s'' = supply of lightweight concrete blocks (EU)

Demand for Total Walling Materials

In estimating the demand for total walling materials in equivalent units of bricks, data on the total net construction area, structural types of buildings (reinforced concrete or masonry) and the average number of bricks necessary per square meter of net construction area for both types of construction are required.

Columns II and III in Table 4.5 show the total gross area of construction in Istanbul, as received from the Chamber of Civil Engineers (IMO)[1] and the Chamber of Architects (IMMO) for the years of 1962-1967.[2] The two institutions mentioned are the only local authorities that approve construction plans. Figures received from IMMO were given for only the first eleven months of the year and are adjusted for twelve months in column IV. Column V shows the total gross area of construction in Istanbul as approved by both chambers. Figures for the total area of construction in Istanbul are also found in the 1965 Statistics Year Book for the years 1959 to 1965 and are shown in column VII.

The difference observed between columns five and seven is caused by

[1] İnşaat Mühendisleri Odası, Istanbul, "Çalışma Raporu, 1967," appendix 8.

[2] Figures received from Istanbul Mimarlar Odası, Harbiye.

TABLE 4.5

Total Construction Area in Istanbul

I Year	II Gross Constr. Area IMO	III Gross Constr. Area IMMO (11 months)	IV Column III Adjusted for 12 months	V Columns II and IV	VI Gross Constr. Area of Unregistered Buildings	VII Net Const. Area within Municipality Limits	VIII Total Net Area of Constr. 1000 sq.m.
1967	1166	2409	2590	3756	300	2430	3245
1966	954	2133	2310	3264	261	2270	2820
1965	975	1888	1985	2960	237	2025	2558
1964	806	1349	1490	2296	184	1622	1984
1963	998	1500	1580	2578	206	1620	2227
1962	1140	1700	1830	2970	238	1807	2566
1961*						1325	1770**
1960*						1014	1350**
1959						968	1290**

* All figures in 1000 sq.m.

** Estimated from column VII

Source: 1965 Statistics Handbook and Monthly Bulletin of Statistics, July 1967.

two factors. One is a difference between the definitions of construction areas. Statistics Year Book figures are for net construction area, whereas figures received from the Chambers of Engineers and Architects are based on gross construction areas. The second factor is that the figures given in column V include constructions in the outskirts of Istanbul which are not considered within municipality boundaries and are not included in the Statistics Year Book.

Neither of the statistics, however, include the unregistered constructions, which according to the Chamber of Civil Engineers[1] constitute 27 percent of the total units, or about 8 percent of the gross construction area.

Column VI shows the gross construction area of unregistered buildings, which is 8 percent of column V for corresponding years.

Column VIII shows the total net construction are in the defined boundaries which is calculated by taking 80 percent of the sum of the figures in columns V and VI and on the assumption that the net area of construction, on the average, equals to 80 percent of the gross area. Having established total net area of construction within the area of study the next step is to calculate the areas of skeleton buildings and masonry buildings.

The distribution of the total net construction area of registered buildings with respect to types of structures is given in Table 4.6.[2]

The average number of equivalent units of bricks per square meter of

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[1] "1967 Çalışma Raporu," Istanbul Mühendisler Odası.

[2] The table is completed on the assumption that all unregistered buildings are masonry structures.

TABLE 4.6

Distribution of Construction Areas According to the Types of Structures

Year	Net Constr. Area of Reinf. Conc. Build. 1000 sq.m.	Net Constr. Area of Masonry Build. 1000 sq. m.	% of Are of Reinf. Conc. Build. to Total	Total Net Constr. Area 1000 sq.m.
1967	2584	661	86 %	3245
1966	2219	601	85	2820
1965	1965	593	83	2558
1964	1506	478	82	1984
1963	1650	577	80	2227
1962	1830	736	77	2566
1961	1361	407	77	1770
1960	1040	310	77	1350
1959	993	297	77	1290

net construction area of masonry structures is fairly constant and can be assumed as 203 units[1].

The average number of equivalent units of bricks used per square meter of net construction area of reinforced concrete buildings varies according to the heights and areas of each flat in the building. However, information on the construction of a controlled site of various heights of buildings and areas of 852 apartment units[1] indicates that for Istanbul this figure can be as-

[1] Dr. Remzi Ülker interview, İTÜ.

sumed to be 118 units per sq. m. of net construction area.[1] Survey results on reinforced concrete buildings which show the net area of construction and number of units of bricks used for various heights and flat areas of buildings support this estimate.

Having now established figures for the total net construction area of the two main types of buildings, and the number of equivalent units of bricks required per square meter of the two types, the total demand for walling materials is calculated and shown in Table 4.7.

TABLE 4.7

Estimation of Total Walling Materials Used

Year	Walling Materials Used in Reinforced Conc. Buildings (million EU)	Walling Materials Used for Masonry Buildings (million EU)	Total D_w for Walling Materials Used (million EU)
1967	305	134	439
1966	262	122	384
1965	232	120	352
1964	178	97	275
1963	195	117	312
1962	216	149	365
1961	161	83	244
1960	128	63	191

(Continued)

[1] Ataköy Sitesi Inşaati

TABLE 4.7 (Continued)

Estimation of Total Walling Materials Used

Year	Walling Materials Used in Reinforced Conc. Buildings (million EU)	Walling Materials Used for Masonry Buildings (million EU)	Total D_W for Walling Materials Used (million EU)
1959	117	60	177

Supply of Substitute Materials

In Istanbul, there are mainly two substitute materials for brick. The one that is more widely used is hollow concrete blocks, manufactured by a large number of small producers. Although statistics are not available on the quantity produced, a good estimate can be made as cement is used in its production and statistics on the amount of cement used by the producers are available (see Table 4.8).

TABLE 4.8

Supply of Hollow Concrete Blocks

Year	Tons of Cement Used by Block Producers	Units of HCB 10^6	EU of Walling Material Supplied 10^6
1967	30,000	15.0	90
1966	26,000	13.0	78
1965	23,500	11.8	71
1964	17,000	8.5	51
1963	16,000	8.0	48
1962	14,000	7.0	42

According to TS 406[1], from a bag of cement 16 to 18 hollow concrete blocks of size 10 x 20 x 20 cm. can be produced. It is however acknowledged[2] that producers of concrete blocks stretch this limit, on the average, to 25 to 30 blocks per bag of cement, sacrificing quality and increasing profits, both by increasing supply and evading taxes.

Noting that a bag of cement weighs 50 kgr. and each concrete block is equivalent to about 6 bricks, the figures in column III and IV are calculated.

The second substitute for bricks is lightweight gas concrete, known by the name of YTONG, produced by the YTONG factory in Pendik which was founded in 1963. The total capacity of YTONG is 70,000 cubic meters[3] of lightweight concrete. However, it is acknowledged that[4] only 76 percent of the production is devoted to walling materials. Considering that for each cubic meter of walling, 500 units of bricks are required, the supply of YTONG as walling material can be calculated:

$$S_s'' = 70,000 \times 0.76 \times 500 = 26,600,000 \text{ equivalent units}$$

Demand for Bricks

Table 4.9 shows the estimated demand for bricks for the years 1962 to 1967 calculated by the method described above.

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1 Türk Standartlar Enstitüsü, TS 406, "Beton Briketler için Standart Taslağı," 1967.

2 Interview with Dr. Remzi Ülker, İTÜ.

3 Dr. Müh. Ünal Öziş, Teknik Büro ve Satış İşleri Şefi.

4 Calculated on the assumption that the rate of increase is equal to that of bricks for the years 1959-1961.

TABLE 4.9

Estimation of Demand for Bricks

Year	D_w	S_s' (million EU)	S_s''	D
1967	439	90	27	322
1966	384	78	27	279
1965	352	71	27	254
1964	275	51	27	197
1963	312	48	27	237
1962	365	42	--	323
1961	244	28	--	216
1960	191	22	--	169
1959	177	20	--	157

Supply of Brick Factories

Depending mainly upon the interviews conducted by three factory managers Table 4.10 is prepared which shows the total number of bricks produced by factories in Istanbul. In the table only those years in which a change on supply occured has been tabulated. For the years not included included in the table the supply is assumed to be equal to the year preceding.

TABLE 4.10

Year	Supply of factories millions of equivalent units 1	2	3	4	5	6	7	Total UE of Bricks Supplied
1920	5	-	-	-	-	-	-	5
1953	10	8	-	-	-	-	-	18
1956	10	10	20	-	-	-	-	40
1960	10	10	20	15	-	-	-	55
1961	10	10	20	20	10	-	-	70
1964	10	14	20	20	10	-	-	74
1965	15	14	35	30	10	10	10	129
1967	15	14	35	30	15	13	13	135

Share of the Brickyards

Having estimated the total demand for bricks in Istanbul and the supply of factories, the shares of the brickyards are calculated by subtracting the supply of factories from the total demand for bricks.

TABLE 4.11

Number of Bricks Supplied by Brickyards

Year	Million Units	% of Total Demand
1967	187	58
1966	150	54
1965	125	37

TABLE 4.11 (Continued)

Number of Bricks Supplied by Brickyards

Year	Million Units	% of Total Demand
1964	123	62
1963	167	70
1962	253	78
1961	146	68
1960	114	67
1959	117	75

Estimation of Future Demand for Bricks

A study of Table 4.1 [illegible] shows that the housing investment in Istanbul is fairly constantly equal to 29 percent of the total housing investment in Turkey and that it has constituted about 84 percent of the total construction in Istanbul. Using figures given in the second five year plan (1965 prices) for housing construction investments (Table 1.1) and assuming that the percentages mentioned above will remain constant over the next five years, the total building construction investment in Istanbul is calculated for the years 1968 to 1972.

In calculating the total construction investments and the total area of construction in Istanbul for the year 1965. This is done for the following reason.

In the estimation of total construction areas for the years between 1968 and 1972, the year 1965 is taken as a base for comparison. In other words, column 4 is calculated implicitly assuming that a square meter of construction will cost the same as in 1965, hence neglecting a possible change in the character of buildings.

TABLE 4.12

Demand for Bricks in Istanbul

Year	1 Housing Inv. in Turkey Mil. T.L.	2 Housing Inv. in Istanbul Mil. T.L.	3 Total Constr. Inv. in Ist. Mil. T.L.	4 Total Constr. Area in Istanbul Mil. sq.m.	5 Estimated demand for Walling material	6 Supply of hollow conc. blocks Mil. EU	7 Supply of YTONG Mil. EU	8 Demand for bricks Mil. EU
1968	3200	920	1105	3.22	435	87	27	321
1969	3800	1102	1312	3.83	517	103	27	387
1970	4100	1189	1415	4.12	556	111	27	418
1971	4300	1247	1485	4.32	583	117	27	439
1972	4600	1334	1588	4.63	625	125	27	473

In 1965 the investment for 2,025,000 sq. m. of construction was valued at 695 million T.L.[1] From here it is calculated that, on the average, each square meter of construction is valued at 343 T.L. Based on this figures column 4 is calculated by dividing all numbers of column 3 by 343.

Column 5 shows the estimated demand for walling materials on the assumption that the structural properties of the buildings constructed in the next five years will not show a significant difference from those of 1967.

Total demand for bricks are tabulated in column 8 based on the as-

[1] Aylık İstatistik Bülteni, Agust 1967.

sumption that the shares of the hollow concrete block producers will remain constant at 20 percent of the total demand for walling materials in the next five years and that there will be no increase in capacity in YTONG factory.

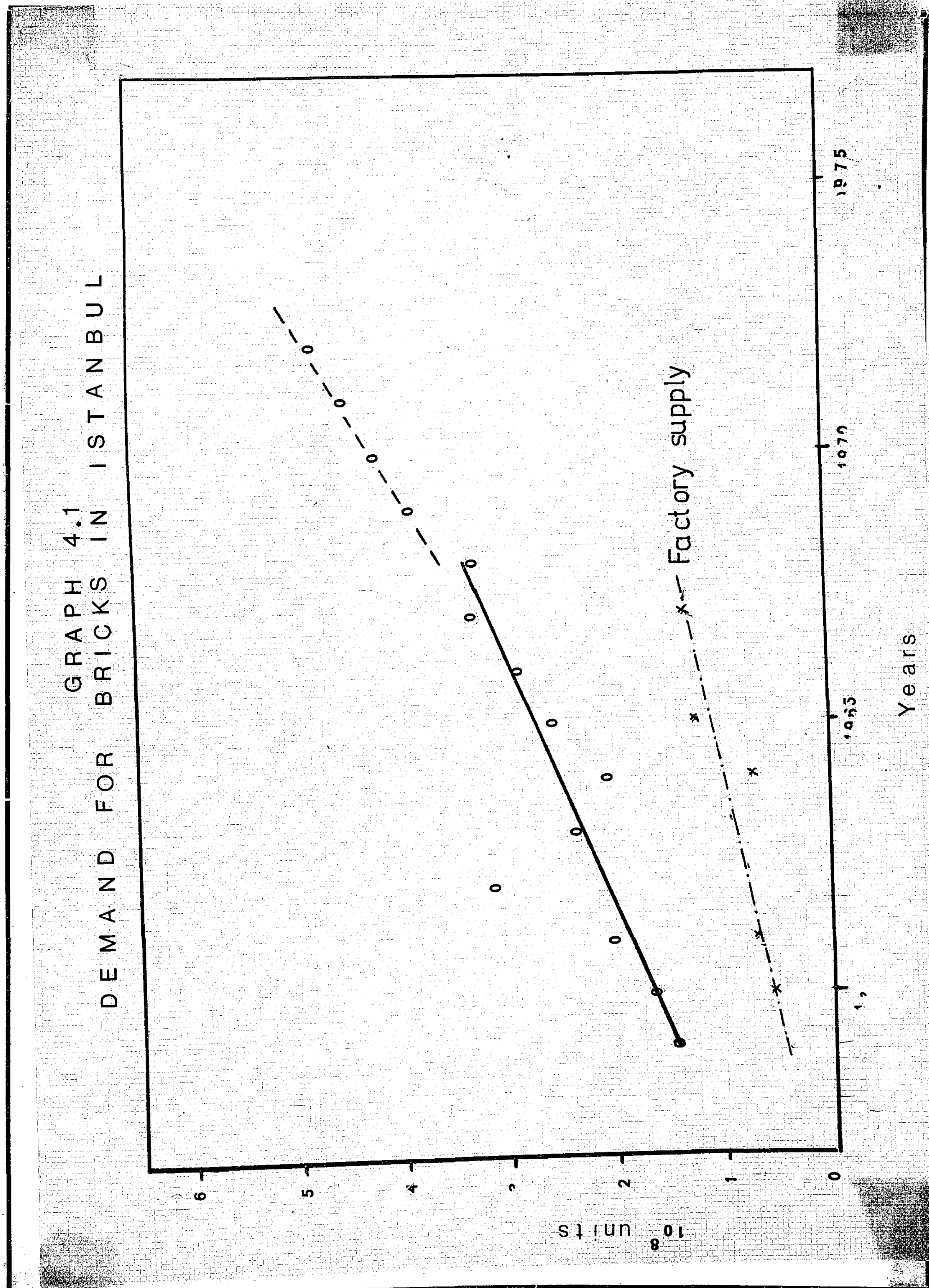
The demand estimated for the future years 1968 to 1972 is shown in Graph 4.1 together with the demand for the years 1959 to 1967 and the factory supplies.

The method followed above in estimating the demand for bricks was based on the investment figures given in the second five year development plan. This method was preferred to the line extension method due to the following reasons:

a) Estimates of housing construction in the first five year plan were realized and the estimates in the second five year plan are continuations of the estimates in the first five year plan.

b) The number of points are too few for a good line extension estimate.

c) Some points, such as the one corresponding to the year 1962, are far off the line due to a concentrated cooperative construction activity which would unduly influence line extension.



GRAPH 4.1
DEMAND FOR BRICKS IN ISTANBUL

D. Quality of Bricks

In brick production each of the six phases described in Section B has significant affects on the quality of the end product. Careless or uncontrolled application of any of the phases introduce additive defects. The properties of most concern to many of the users of bricks are size variation, regularity of shape, absorbtion and compressive strength. However, there is a high negative correlation between strength and absorbtion.[1] Therefore in considering quality in this paper stress is given to compressive strength, size variation and regularity of shape of the bricks. In order to make an objective quality comparison between factory produced bricks and hand bricks ten samples of bricks were taken from each of the twelve brickyards visited and tested for the above mentioned properties. No bricks were taken from the factories, however, due to the fact that the test results on the same properties were available in the files of Materials Laboratory of the Istanbul Technical University. The following is a summary of the results of the properties of bricks tested or on which data was obtained.

Factory Products

Factories following a modern and controlled method of production do not have any problems of attaining sizes and regularity of shape. The dimensions of all the factory produced units tested fall within the dimensional tolerance given in the Turkish Standards. The results of tests conducted on the

[1] Brick and Tile Engineering, p. 36

Materials Laboratory of the Istanbul Technical University between the years 1962 to 1968 show that the compliance with size has been satisfied by almost all factory produced bricks.

Compressive strength test results for the last two years indicate that solid bricks which are produced only in two factories are above the average strengths specified in both the existing and new tentative standards for first grade solid bricks (Table 2.4).

Perforated load bearing brick strengths are much higher than the required values for first grade and even at three standard deviation values an individual unit does not fall below the minimum required strength valve. The coefficient of variation within the samples are small which prove that homogeneity is attained on the production.

However, in regard to hollow bricks the situation is different. Of the three sample test results none comply with the specified average compressive strength given in the standards for even second grades of hollow bricks. A discussion of this result will be made in Chapter V.

Brickyards

Information received from the survey shows that in none of the brickyards were any tests conducted to determine the properties of the raw materials used while choosing the site or afterwards, and no tests were conducted to determine the quality of the bricks produced. It is acknowledged that the type of clay at site, as well as the quality of bricks produced were decided

TABLE 4.13

COMPRESSIVE STRENGTH TEST RESULTS OF FACTORY PRODUCED BRICKS

		Factory 1	Factory 2	Factory 3	Factory 4	Factory 5
SOLID BRICKS	$\bar{X}$ (kg/cm^2)	214			354	
	S (kg/cm^2)	9.2			48.1	
	V (%)	4.3			13.4	
PERFORATED BRICKS	$\bar{X}$ (kg/cm^2)	220	227	206		
	S (kg/cm^2)	10.1	20.0	31.0		
	V (%)	4.5	8.8	15.0		
HOLLOW BRICKS	$\bar{X}$ (kg/cm^2)		34	32		34
	S (kg/cm^2)		5.0	4.0		4.2
	V (%)		14.7	12.5		12.4

$\bar{X}$ - Average compressive strength

S - Standard deviation of sample

V - Coefficient of variation

upon by observation. In deciding about quality of bricks a dark red color is associated with a good product. However, due to the influence of chemical composition on color there is no direct relation between strength and color that can be applied to all products.[1] This is especially true when the quality is judged by the buyer on the basis of color because with bricks produced from different types of raw materials the relation between color and quality is even far more vague.

In order to determine the quality of bricks produced in the brickyards the samples taken were tested for their dimensions, compressive strengths and compliance for squareness in the Materials Laboratory of the Istanbul Technical University.

Compressive tests were made in conformity with Turkish Standards as explained on page 15 item 9 . The average compressive strengths, standard deviations and coefficients of variations of each group of samples were calculated and these are tabulated in Table 4.14. From Table 4.14 it is seen that of the twelve samples tested only one, does not satisfy the minimum average strength specified in the standards for second grade hand bricks and four samples do not fullfill the requirement of minimum individual strength. According to the tentative standards six groups of bricks would be classified first grade, two would be classified as second grade and four would be rejected due to compressive strengths. However, when coefficient of variations and standard deviations of the sample groups are considered, the great

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[1] Brick and Tile Engineering

heterogeneity of the products becomes obvious. Graph 4.2 is included to reflect this fact which shows the averages and two standard deviation limits for the samples tested in graphical form.

TABLE 4.14

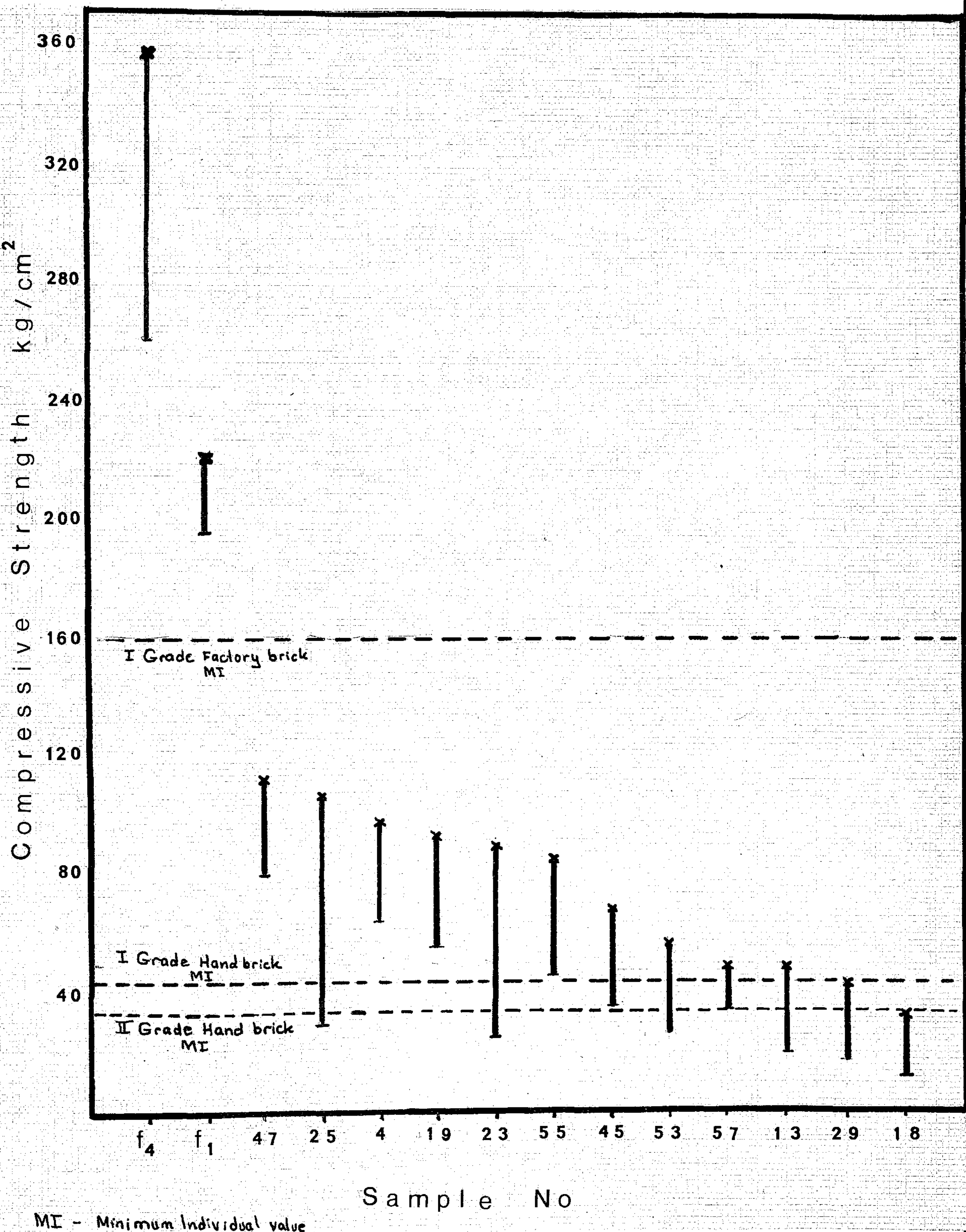
Compressive Strength Test Results of Solid Bricks Obtained from Brickyards

No.	Location	Compressive Strength Average	Minimum Individual	Standard Deviation Kg/sq.cm.	Coefficient of variation %	Grade TS
4	Üsküdar	99	75	17.5	17.8	I
13	Eyüp	49	32	15.2	31.1	-
18	Bakırköy	36	24	11.4	31.7	-
19	Ayazağa	93	60	19.7	21.1	I
23	Üsküdar	91	61	33.3	36.6	I
25	Bakırköy	108	51	39.0	36.1	I
29	Eyüp	45	25	12.2	27.1	-
45	Eyüp	70	40	18.0	25.8	II
47	Ayazağa	113	95	15.7	13.9	I
53	Üsküdar	56	29	25.5	27.7	-
55	Kağıthane	86	50	20.5	23.8	I
57	Unkapanı	50	38	7.1	14.2	II

In testing for conformity to standard dimensions the existing standards had to be taken as the basis for comparison since dimensions given in the new tentative standards are still not applied. However, the method is

GRAPH 4.2

AVERAGE STRENGTH AND THE LOWER TWO STANDARD DEVIATES OF THE SOLID BRICKS TESTED



standard which required piling ten bricks on top of each other and measuring the total height to determine the average height was not able to be followed because not more than 6 to eight units could be placed on top of each other without the pile collapsing. Therefore each unit was measured separatley at various sections and the average of these readings was taken as the height of the specimen. Table 4.15 shows the dimensional test results from which it can be observed that of all twelve samples only one (No. 19) is in conformity with the standard dimensions.

As for the compliance to regularity of shape only three samples out of twelve were found to be in accordance with the standards (Nos. 14, 19 and 47).

The results of test conducted on samples show that a great heterogeneity exists in the hand bricks, and though the average minimum compressive strength requirement is in general attained, the large standard deviations offset the benefits to be derived from the required average strength. The heterogeneity in size, regularity of shape and strength are also mainly caused by the defects pointed out in Section B.

TABLE 4.15

Sizes of Bricks Obtained from Brickyards

No.	Average Length (mm)	Standard Deviation (mm)	Average Width (mm)	Standard Deviation (mm)	Average Height (mm)	Standard Deviation (mm)
4	214	1.2	104	1.5	67	1.8
13	210	4.1	102	0.7	64	1.7
18	208	1.9	102	1.3	66	1.0
19	214	2.8	101	2.1	61	1.7
23	207	3.5	99	1.4	63	1.7
25	215	3.2	101	2.2	66	2.4
29	213	4.1	102	0.7	66	1.7
45	209	3.8	100	1.5	65	2.1
47	211	3.4	101	3.1	64	1.7
53	214	4.0	101	2.1	63	3.0
55	207	3.4	100	2.2	61	1.7
57	205	2.0	99	1.9	66	2.6

E. Sales Prices

Factories

There are relatively few brick factories and the products of these factories being homogeneous the basic characteristics of an oligopoly situation exists. The two largest companies which share almost 80 percent of the sales of factory produced bricks (Topser, Paşabahçe and Küçüksu factories are operated by the same company) are the price leaders and the others follow these prices. The existance of substitutes, however, sets a limit to the price that could be charged.

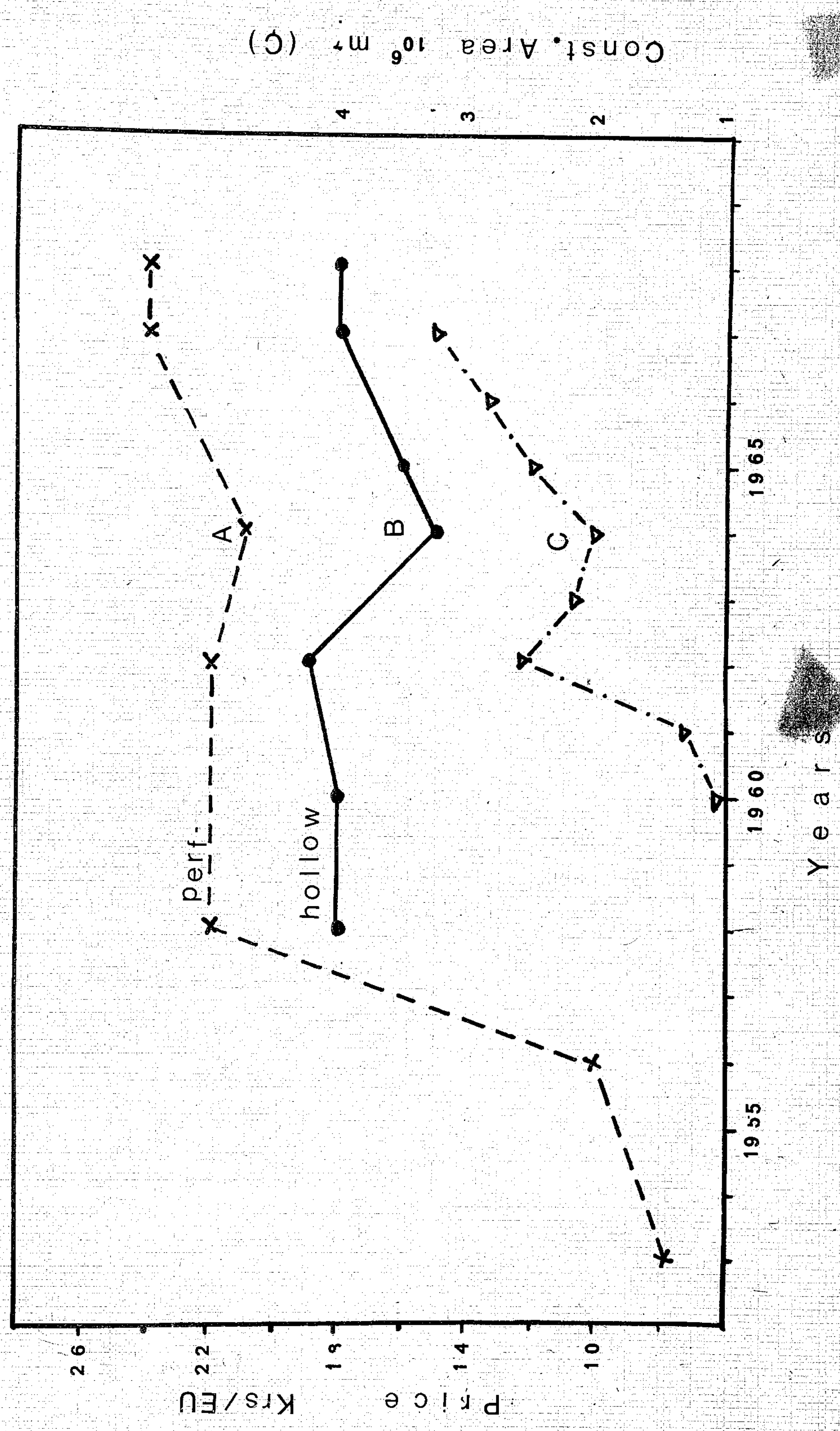
An analysing prices of bricks in various years together with the construction activity in Istanbul clearly indicated that prices follow closely the construction activity (Graph 4.3).

Bricks of various types and sizes are produced by all factories and these are referred to as multiples of equivalent units of solid bricks. However, there are some variations between the line of sizes of the two largest companies. The factory prices of Topser and Topel bricks for the most common sizes are shown in Table 4.16.

As can be observed from Table 4.16 factory prices are fixed at 18 Kr. per equivalent unit for hollow bricks and 19 kr. per equivalent unit of perforated bricks. Though it is possible to purchase bricks from the factories it is acknowledged that almost 90 percent of the delivery is made by company trucks. In case of delivery to site, zone pricing policy is followed. The city

GRAPH 4·3

CHANGE IN PRICES OF FACTORY BRICKS



is divided into three zones and depending upon the average distance of over-haul all buyers in the same zone pay the same price. For the longest over-haul distance in Istanbul an extra price of 2 kr. is charged per equivalent unit of brick delivered.

TABLE 4.16

Equivalent Units	Dimensions	Topser	Topel
	Hollow Bricks (Non Load Bearing)		
2	22x11x10.5	36	--
4	22x22x10.5	72	72
6	33x22x10.5	108	--
8	22x22x22	144	144
12	33x20x20	216	--
	Perforated Bricks (Load Bearing)		
1	22x10.5x6	--	24
1	22x10.5 x 6	--	28
6	33x21x11	114	--
8	33x22x14.5	152	--
12	33x22x21.5	228	--

Brickyards

The prices of solid bricks vary widely among the brickyards (Table 4.5). The average price per unit for the twelve observed brickyards is 12.9 kr. per unit with a standard deviation of 2.1 kr. per unit.

It is interesting to note that information based on the survey results does not indicate any significant correlation in prices versus quality or prices versus sales (Graphs 4.4 and 4.5). There is not even an apparent relation between price and location although one would normally suspect that there would be. An analysis of variance test conducted on the following data (Table 4.17) taken from table 4.4 show that the null hypothesis of prices being equal for three districts cannot be rejected at an $\alpha = 0.05$ limit.

TABLE 4.17

Location-price relation for hand bricks

	Locations		
Observations	Eyüp Krş/unit	Üsküdar krş./unit	Bakırköy krş/unit
1	11	15.5	10.0
2	16	12.0	15.0
3	13	13.0	
X	40	40.5	25.0
N	3	3	2
$\overline{X}$	13.3	13.5	12.5

Total sum of squares = 35

Total sum of squares among samples = 3.2

Total sum of squares among samples = 31.8

$$F = \frac{31.8/5}{3.2/2} = 4$$

With a 2 and 5 degrees of freedom the 0.05 level of F is 19.25. Therefore, the null hypothesis that there is no significant price difference in various locations cannot be rejected.

Though it is normally uneconomical to manufacture bricks in the brickyards due to a great heat loss while burning the bricks and the inefficient mining and molding phases, on the average the price of hand bricks is lower than that of an equivalent unit of factory produced bricks. Considering also that a solid brick requires about twice as much raw material usage and handling as an equivalent unit of hollow brick the high price of factory produced bricks can be attributed mainly to the market situation discussed. However, certain other factors of importance should also be considered which would reduce the cost of production of the brickyards. These factors are:

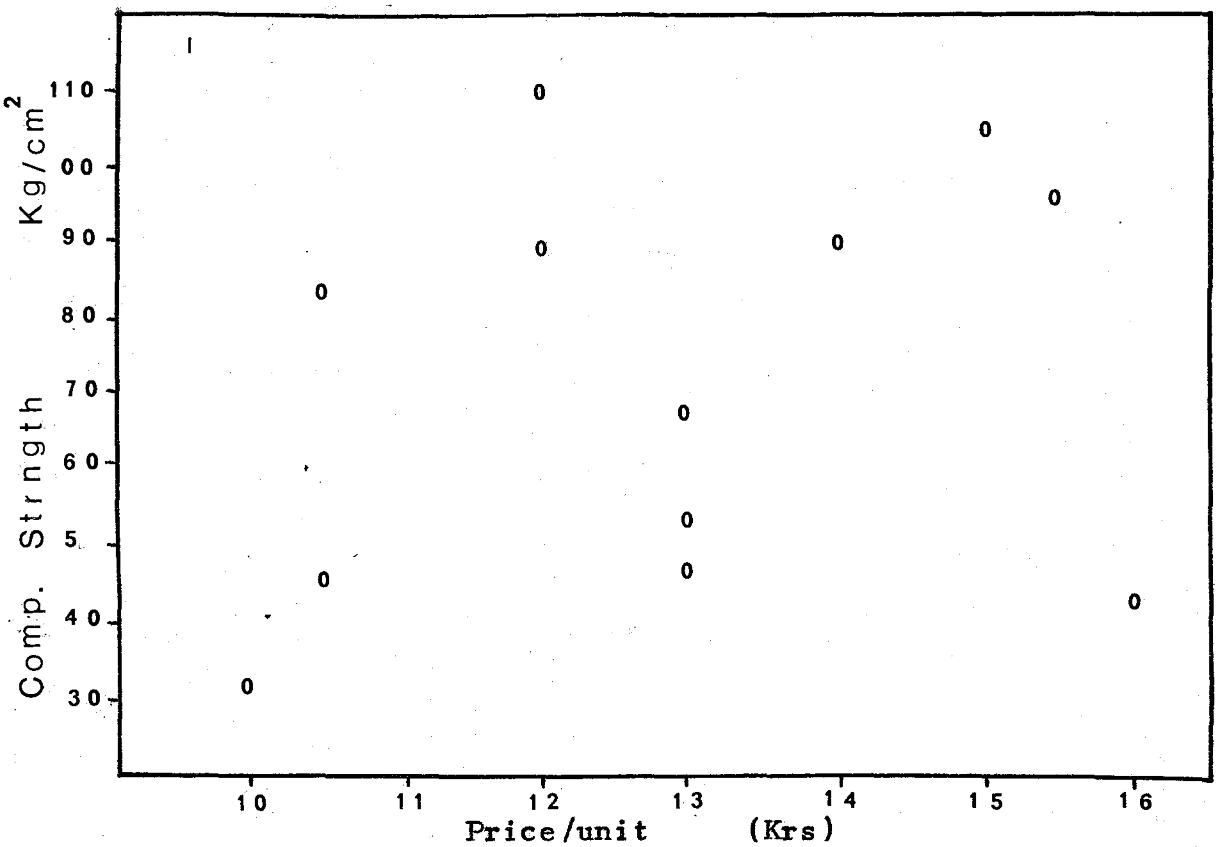
a) Brickyards do not have any fixed investment in assets, therefore, no problem of return on investment exist.

b) Labor costs are very low and seasonal in the brickyards.

c) Tax evasion is easily exercised by the brickyards.

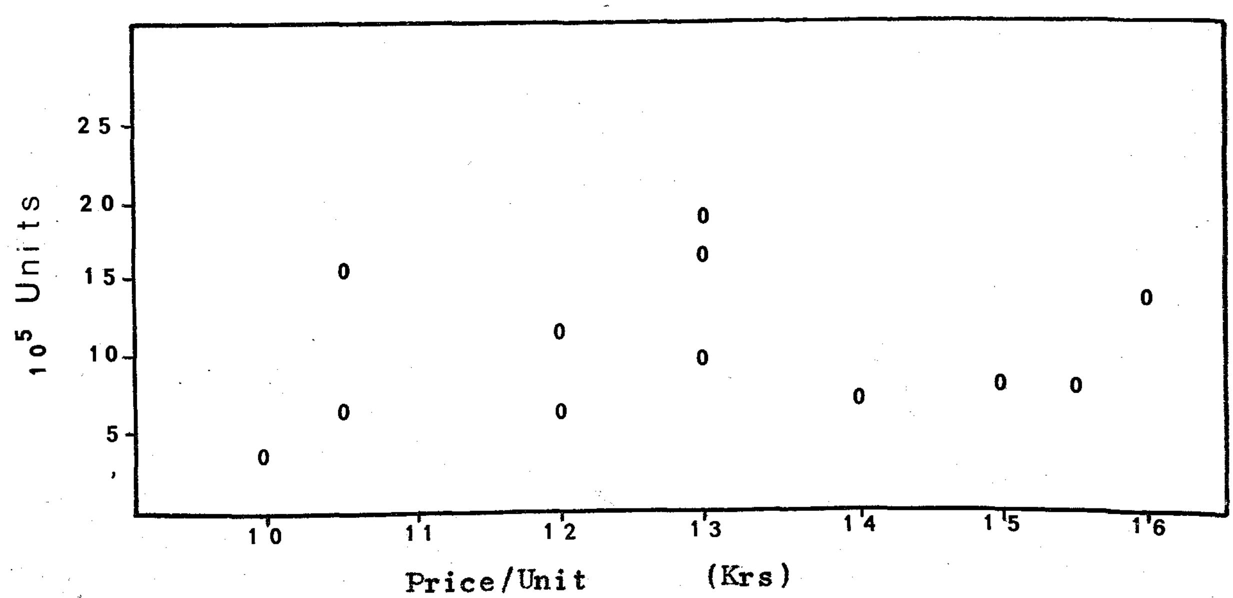
GRAPH 4.4

PRICE vs. STRENGTH OF HAND BRICKS



GRAPH 4.5

PRICE vs. SALES OF HAND BRICKS



CHAPTER V

CRITICAL EVALUATION OF THE REASONS FOR USING HAND BRICKS GIVEN BY USERS

An analysis of Tables 4.5 and 4.9 shows that since 1959 the construction activity in the Istanbul area has increased from 1.3 to 3.2 million square meters and the demand for walling materials has increased from 177 million units to 439 million units. Within the same years four new factories have been established and almost all the factories have somewhat increased their capacities. However, all this has accounted to an increase of 95 million units in the supply of factory-produced bricks (Table 4.10). The increase in factory supply accounts for only 36 percent of the increase in walling material demand. Due to the fact that there has been a great increase in demand for bricks and the supply of factories is limited by capacity some would-be users of factory bricks have chosen to use hand bricks instead because of their easy availability on short notice. A great increase in the shares of brickyards in 1962 along with the increasing construction activity supports the point that many probable users of the factory bricks were diverted to the use of hand bricks (Table 4.11). However, a survey conducted to determine the causes of using this particular type of brick, which covered twenty buildings under construction where only hand bricks were used, shows that the present distribution of supply could be based on certain other factors along with the capacity limitations of the factories.

In the survey the main reason given for the use of hand bricks was its low cost. Fourteen of the twenty users gave the reason of low cost for their usage. Other common reasons were the ready availability and strength of hand bricks as compared to hollow bricks. In tow of the constructions the contractor was found to own a brickyard (Table 5.1).

The same survey results show that the average cost of a hand brick at the construction site was 15.5 krş. per unit as compared to an average equivalent unit cost of 19 krş. for factory produced hollow bricks. However, the consideration of the cost of bricks alone does not reflect a true comparison of the cost of the functional unit which is the wall, for the cost of the wall depends upon other factors such as the cost of mortar used, cost of wastage , cost of placing and plastering, etc. In the case in which the user of the bricks will himself fire in the building and/or pay for the heating and maintenance, the running costs are also a relevant factor to be considered. Therefore the reason of low cost for usage of hand bricks necessitates a comparative cost analysis for validity.

In the following pages the validity of the reasons given by the users of hand bricks will be evaluated.

TABLE 5.1

Survey Results on Constructions Where Solid Hand Bricks Are Used

Location	No. of flats	Total gross area (sq.m.)	Cost at site (Krş.)	Reasons given for the use of solid hand bricks C	A	W	S	Other
Bakırköy	5	1100	16	x	x			
Fındıkzade	6	330	16	x	x			
Üsküdar	3	540	14	x	x			owns b.y.
Şişli	6	810	14	x				
Taksim	1	110	13	x	x			temporary
Etiler	5	600	16	x				
Esentepe	4	4000	15					owns b.y.
Eminönü	4	840	11		x		x	
Fatih	5	1080	17	x	x			
Fatih	4	440	19	x	x	x		
Beşiktaş	4	540	16		x	x	x	
K. M. Paşa	5	600	17				x	
Şişli	3	600	18		x			
Altunizade	2	340	13	x	x			
Suadiye	2	240	20				x	x
Levent	4	1200	17			x		
Üsküdar	3	480	14	x		x		
Yeniköy	4	520	17	x				
Levent	3	330	15	x			x	
Bakırköy	4	380	13	x				
TOTALS		15080		13	10	2	7	4
Average		754	15.5					

C - Low cost A - Availability

W - Workability b.y. Brickyard

S - Strength

TABLE 5.2

Survey Results on Constructions Where Hollow Bricks Are Used

Location	No. of flats	Total gross area (sq. m)	Reasons given for the use of hollow bricks							
			A	W	S	L	H	I	O	T
Bebek	6	1890		x						
Bakırköy	5	1100	x	x		x				
Pangaltı	8	1800				x	x			
Beşiktaş	7	1020				x	x			
"	6	920	x	x	x					
Nişantaş	9	4500				x				
Levent	5	880	x	x	x					
Üsküdar	4	1840	x	x	x					
Esentepe	13	6500	x	x	x	x	x			x
Beşiktaş	6	512	x	x	x			x		
Fatih	6	540	x	x	x		x	x		x
Beşiktaş	6	1800	x							
Teşvikiye	4	1040			x			x		
Kabataş	6	1980		x	x					x
Beşiktaş	7	600	x	x	x	x		x		
"	6	1500		x	x					
"	6	1500	x	x	x					
Beyoğlu	3	1870	x	x	x		x			
Maltepe	6	2330	x	x						x
Şişli	7	770	x	x	x		x			
Beşiktaş	7	3640	x	x				x		
"	7	1900	x	x	x					x
Etiler	8	4400	x	x	x	x				
Levent	11	1700				x	x			
Kadıköy	6	606	x	x	x	x				
TOTAL		46138	17	19	16	9	7	5		5
Average		1845 sq.m.								

TABLE 5.2 (Continued)

A - Availability

W - Workability

S - Strength

L - Lightness

H - Heat insulation

I - Sound

T - Time saving

O - Others

TABLE 5.3

Survey Results on Constructions Where Perforated Bricks Are Used

Location	No. of Flats	Total gross area (sq.m.)	A	W	S	L	H	I	O	T
Büyükdere	5	1400			x					
Ergenekon	7	588	x		x					
Şişli	8	2240		x	x		x	x		
Vezneciler	6	3600			x			x		
Eyüp	4	400		x	x					
Ihlamur	5	3450		x	x		x	x		
TOTAL		11678	1	3	6	0	2	3	0	0
Average		1946								

A - Availability
W - Workability
S - Strength
L - Light Weight
H - Heat insulation
I - Sound insulation
O - Others
T - Time saving

A. Analysis of the "Low Cost" Factor

In the comparative cost analysis, running costs as well as the initial costs related to the construction of a solid brick wall and a hollow brick wall will be discussed.

A thick brick wall, the most common thickness of exterior walls in Turkey, will be considered for comparison. The same analysis could be applied for an exterior wall of any thickness with minor modifications.

Since the analysis is of a comparative nature and the sources of all costs are the same, the problem is tackled by comparing only costs that differ in amount. In the analysis the sum of the differences of relevant costs will be compared. The cost of various items related to constructing the hollow brick wall will be subtracted from the cost of the solid brick wall for the same item. A negative difference for the cost of an item will then show that for that item the cost of the hollow brick wall is lower by the given amount. Calculation of total difference in the initial costs (DC_1):

The main relevant initial costs that should be compared for a relatively accurate analysis are the following:

1. Cost of bricks (C_1)
2. Cost of wastage in bricks (C_2)
3. Cost of mortar (C_3)
4. Cost of placing (C_4)
5. Cost of plastering (C_5)

6. Cost caused by difference in unit weight

In the following comparative cost analysis item 6 will not be considered as this factor changes a great deal depending upon the height of the building. However, it should be mentioned that item 6 is of importance especially in high skeleton buildings where the walling material is of non load-bearing character and the load is carried by columns and girders. Hence, the cost of the building is increased appreciably by using a heavier material for walling due to an increase in the dimensions of the columns and girders.

The analysis given below is carried out for one square meter of wall of one brick thickness:

Difference in cost of bricks (DC_1):

As observed in the survey the average unit cost of hand bricks at construction site is 15.5 krş., whereas the price of 4 equivalent units of hollow factory bricks is 76 krş. Making use of Table 5.4 which shows the number of bricks, volume of mortar and required placing time for one cubic meter of wall the difference in cost of bricks is calculated.

$$DC_1 = 159 \times 0.22 \times 0.76 - 497 \times 0.22 \times 0.155$$

$$DC_1 = 9.60 \text{ T.L.}$$

Difference in Cost Due to Wastage of Bricks (DC_2):

Literature surveys show that on the average a waste of 15 percent and a waste of 5 percent is caused respectively for hand bricks and factory bricks during transportation and handling.

$$DC_2 = 0.05 \times 159 \times 0.22 \times 0.76 - 0.15 \times 497 \times 0.22 \times 0.155$$

$$DC_2 = -1.22 \text{ T.L.}$$

TABLE 5.4

Materials and Placing Time Required for Constructing 1 m^3 of Wall

Type of Bricks	Placing Time (min.)	Volume of mortar (m^3)	Number of bricks required
Solid	185	0.263	497
Hollow 4EU	123	0.126	159

Source: İ.T.Ü. Yapı Araştırma Kurumu Raporu, Seri D, Sayı 3, 1964

Difference in Cost of Mortar (DC_3):

The cost of one cubic meter of mortar is given in 1967 unit price lists of the Ministry of Public Works as 112.05 T.L. Using the figures given in Table 5.4 for the amount of mortar used, the difference in cost of mortar is calculated:

$$DC_3 = 0.126 \times 0.22 \times 112.05 - 0.263 \times 0.22 \times 112.05$$

$$DC_3 = 3.3 \text{ T.L.}$$

Difference in Cost of Placing (DC_4)

This cost is equal to the number of hours worked in constructing a square meter of wall times the hourly cost of a worker. Taking the wage of the worker per hour as 2.75 T.L. and the time required from Table 5.4 the difference in cost of placing is calculated below:

$DC_4 = \frac{123}{60} \times 0.22 \times 2.75 - \frac{185}{60} \times 0.22 \times 2.75$

$DC_4 = -0.63$ T.L.

Difference in Cost of Internal and External Plastering (DC_5):

Due to the regularity of the shape of factory bricks and the fact that their average length is 1 cm. longer than the average length of hand bricks, the thickness of plastering required is reduced by about one fourth, thereby reducing the cost of plastering by about one fourth also. Tables of unit prices indicate that plastering of a wall costs about 17.01 T.L. per square meter. The difference in cost of plastering, therefore, could be estimated as $\frac{17.01}{4}$.

$DC_5 \simeq -4.25$ T.L.

The total difference between the initial cost of constructing a square meter external wall by hollow bricks and solid bricks can now be calculated as the sum of the difference of the five items considered.

$DC_1 = 9.60 - 3.36 - 0.63 - 1.22 - 4.25$

$DC_1 = 0.12$ T.L.

This result shows that when hand bricks are used instead of hollow bricks, in an external wall of one brick thickness, a saving of 0.12 T.L. in the initial cost of each square meter of wall is possible, assuming that both materials are obtained at average prices.

Calculation of the Difference in Running Costs (DC_R):

Under this heading two factors could be considered. The first factor is the annual difference in heating costs caused by the difference in thermal resistivity of the walls constructed from hand bricks or hollow bricks. The second factor is the difference in maintenance costs. This factor, however, will not be included in the following analysis since it is minor compared to the first factor. Though it is generally accepted that hollow brick walls require less maintenance costs, no numerical data on this aspect exists in the literature.

Difference in Annual Cost of Heating (DC_A):

The resistance of a wall to the passage of heat is given by the equation[1]

$$B = \frac{1}{k_1} + \frac{t_1}{z_1} + \frac{t_2}{z_2} + \cdots + \frac{t_n}{z_n} + \frac{1}{k_o}$$

where B is given in $hrm^2\ ^oC/K\,Cal$ and constitutes the thermal resistivity of the wall in question. k_1 and k_o are the boundary layer heat transfer coefficients at the outside and inside of the wall and t's are the thicknesses of layers of wall in meters and z's are coefficients of thermal conductivity. The valves of k which depend upon the direction of flow of heat and wind conditions are given below.[2]

	Direction of flow	$K^k Cal/m^2\,hr\ ^oC$
Closed place	horizontal	7
Open place	All directions under wind conditions of 2 m/sec	20

[1]Ferruh Kocataşkın, Yapı Malzemesi Bilimi (Istanbul: 1967), Vol. II

[2]Ibid.

The reciprocal of B valve is the overall heat transfer coefficient or U valve which is measured in units of K Cal/hr m^2 ^oC.

The quantity of heat (Q) that passes through each square meter of wall in an hour is $U(T_1 - T_o)$ where T_o and T_1 are the internal and external air temperatures in ^oC. To calculate the annual heat loss from a unit area, the concept of degree days per annum should be introduced. This is the summation of the difference between an arbitrary internal room temperature and the average external air temperature for each day (only for those days that the external temperature is less than the arbitrary internal room temperature). The degree days per annum for a location can be calculated by the equation,

$$G = D(T_p - T_i)$$

where G is the degree days per annum and D is the number of days external temperature is less than the base temperature. Here T_i is the base temperature and T_p is the average external temperature. The annual heat loss (Q_A) from a square meter of area can then be calculated by,

$$Q_A = 18\ U\ G$$

assuming that the building will be heated for 18 hours of the day. And the cost of fuel consumption per year for each square meter of wall can be calculated by the formula,

$$C_R = Q_A \frac{K}{EV}$$

where K is the cost of fuel in T.L. per liter or Kg. of fuel used, E is the efficiency of the heating system and V is the heat value of the fuel in K Cal/Kg.

Combining all the above given formulas the annual cost of heat loss from each square meter of wall is

$$C_R = 18 \cdot U \cdot G \cdot \frac{K}{EV}$$

or

$$C_R = 18 \frac{G}{\frac{1}{k_1} + \sum \frac{t_i}{z_i} + \frac{1}{k_o}} \cdot \frac{K}{EV}$$

where

K -	Cost of fuel (coal) in Istanbul	25 krş./Kg.
E -	Efficiency of system	70 percent
V -	Heat value of coal	7000 K Cal/Kg.
G -	Degree days per annum in Istanbul	2254 degree-days

Source: Ruhi Kafesçioğlu, İmer Sunguroğlu, Yapı Malzemesi Seçme Ders Notlarına Ek, İ.T.Ü.

With the use of the annual cost of fuel formula derived above a comparison between the use of solid bricks and hollow bricks from the point of view of heating costs can be made.

Annual Cost of Heating Per Square Meter of Hollow Brick Wall (C'_R):

$$C'_R = 18 \frac{2254}{\frac{1}{7} + \frac{0.025}{1.00} + \frac{0.22}{0.35} + \frac{0.15}{0.60} + \frac{1}{20}} \times \frac{0.25}{0.7 \times 7000}$$

$$C'_R = 2.38 \text{ T.L./m}^2\text{/year}$$

Annual Cost of Heating Per Square Meter of Solid Brick Wall (C''_R):

$$C''_R = 18 \frac{2254}{\frac{1}{7} + \frac{0.03}{1.00} + \frac{0.21}{0.70} + \frac{0.02}{0.60} + \frac{1}{20}} \times \frac{0.25}{0.7 \times 7000}$$

C''_R = 3.74 T.L. / m^2 / year

Difference in Annual Cost of Heating (DC_R):

$$DC_R = C'_R - C''_R = 2.38 - 3.74 = -1.36 \text{ T.L.}/m^2/\text{year}$$

The above computations indicate that when solid bricks are used instead of hollow bricks, all other factors remaining constant, there is 1.36 T.L. difference in cost of heating per square meter of wall annually. This figure would be somewhat higher if fuel oil or kerosene is used for heating purposes.

Table 5.5 has been prepared, following the method presented above, to show the difference in cost of using hand bricks and hollow bricks per square meter of wall for various prices of hand bricks and hollow bricks at the construction site.

TABLE 5.5

Difference in Cost of Using Hand Bricks v.s. Hollow Bricks

Cost of Hand bricks	Cost of an EU of hollow bricks 19 krş.	20 krş.	Annual Cost of Heating
17	-1.72	-0.25	-1.36
15.5	0.12	1.59	-1.36
14	2.05	3.52	-1.36
12	4.33	5.80	-1.36

From Table 5.5 it can be observed that in a location where hollow bricks cost 19 krş./EU and hand bricks cost 15.5 krş./unit, even the initial cost of walls are almost equal. The same table indicates that in a construction where 20 krş. is paid for an equivalent unit of hollow brick instead of using solid bricks at a cost of 12 krş. per unit, the additional cost of 5.80 T.L. would be paid back within four years.

In calculating the figures in Table 5.5 a factor of great significance for high buildings, the reduction in weight due to the use of hollow bricks, was not considered. The inclusion of this factor would probably lead to a conclusion that for buildings of more than 5 flats the use of hand bricks at any possible price would be uneconomical.

The above analysis shows that almost anywhere in Istanbul using hand bricks in a wall that is to be plastered and where hollow bricks could be used and paying more than 15.5 krş. per unit increases the cost of the wall, even if running costs are not considered or not relavant.

B. Study of the "Ready Availability" Factor

In the survey the next most common answer received (eleven of the twenty users) for the reason of choice of hand bricks was its ready availability. In the interviews conducted with factory managers it was expressed that a shortage of hollow bricks during the months of March or April was out of the question. In these months the stock was stated to be at its highest level, ready for the high construction activity months of May and June. This statement was confirmed by observation also. However, it was expressed that toward the end of May factories could not meet the demand for factory-produced bricks. Another point which supports the lack of difficulty in obtaining hollow bricks during the period of survey is provided by the users of hollow bricks. The results of the survey made in constructions where hollow bricks were used bear the fact of their availability during this period out (Table 5.2).

However, one point here is worth consideration. For a construction which starts in the beginning of April it may not be possible to order the total quantity of bricks to be used during the construction time due to a lack of available space or the financial situation. Hand bricks being able to be obtained in parts on short notices from one of the brickyards could be considered more readily available.

The above discussion, however, was mainly concentrated on the months of March and April. In Istanbul the construction activity reaches its peak in the month of May and continues at a high level till September. Within these months the supply of the factories is well below the demand for bricks. Here also the previous experience of a user who once failed to obtain factory produced bricks at the desired time may be one of the important factors in his judgement about the difficulty of obtaining factory bricks. Thus, it is seen that although there is a lack of factory bricks during the peak of construction activity, during other months there is almost no question of their availability in spite of opinion to the contrary.

CHAPTER VI

GENERAL CONCLUSIONS

In Istanbul the need for an organized, rational development of the brick industry is seen to be of great significance when the increase in construction activity and the important role of bricks in this activity is considered. In 1967 about sixty million liras were consumed on bricks in the Istanbul area, and it is estimated that in 1972 this figure will rise to over eighty million liras (by 1967 prices). Considering that about 85 percent of this consumption (Table 4.1) will be on housing projects and that in the second five-year development plan it is aimed to keep the investment in housing at a fixed 20 percent of the total investment, the importance of a well planned steady development of this industry becomes obvious. Equally important for the economy is not only the amount consumed on bricks, but also what is created by this investment. When the present situation is considered, serious defects are exposed.

One of the main points to be considered is the quality of the bricks on which such a great sum is invested and the general affects of the properties of the materials used. The study of production methods of the brickyards and test results on the samples received from the brickyards show that, with the present methods followed, the production of good and consistent quality of bricks in the brickyards is highly improbable. Having estimated the average sale of a brickyard and the total supply offered by brickyards it could be estimated that in Istanbul 125 to 150 brickyards are in operation today. These brickyards are able to offer lower prices than the factories not as a result of their efficiency but due to the reason that they could avoid legal responsibilities. Table 4.11 shows that in Istanbul 65 percent on the average of the total supply of bricks has been covered by hand bricks since 1959. The cost analysis in chapter V indicated that the use of hand bricks wherever replacable by hollow bricks proves to be more costly even under the present price system. It is shown that any price paid for hand bricks at the construction site over 15.5 krş. per unit increased the initial cost of the wall, and under normal heating conditions where applicable, for each square meter of exterior walling a loss of 1.36 T.L. is created as a result of using hand bricks instead of hollow bricks. Considering the results of the second survey conducted, eleven of the twenty users of hand bricks paid more than 15.5 krş./unit at the construction site (Table 5.1). The increase in the initial cost of the building as well as the increase in annual heating expenditure when hand bricks are used is evident.

The analysis of the demand for walling materials in Istanbul reveals that the share of factories has not shown a steady increase. In the years that new factories are established or the capacities of the existing factories has increased their share has also increased. However, the increase in the supply of the factory bricks has not kept up with the development of the building construction activity in Istanbul. Table 6.1 which is compiled from Tables 4.7

and 4.10 illustrates this point.

TABLE 6.1
Distribution of Supply between Factories and Brickyards

Years	Total demand for walling materials million units	Factory supply million units	% Share of Factories
1967	439	135	31
1966	384	129	34
1965	352	129	31
1964	275	74	27
1963	312	70	22
1962	365	70	19
1961	244	70	29
1960	191	55	29
1959	177	40	23

In the Istanbul area it has been estimated that the demand for bricks will increase by about 30 million units each year up to 1972.(Table 4.12). The factories existing today are not in a position to increase their supplies any-where this amount. Therefore the need for new investments in this industry is of great importance when the rational and directed development of the con-struction activity in Istanbul as well as the general economy of Turkey is con-sidered.

As it is now the presence of brickyards is essential in order to meet the great demand for walling materials in Istanbul though the quality of hand bricks are much below the desired level for use in many places. However, due to the fact that such a great share held by the brickyards cause a great waste of resources, a future planning by government directed toward a competitive brick industry is necessary. This would increase the shares of the factories and benefit the users and economy by competitive prices offered. If new investment are not urgently undertaken, with increasing demand a price increase in the factory produced bricks should be expected as has been the case in the past (Graph 4.3).

The present distribution of market shares of brickyards and factories is believed to be caused by three main factors which to a certain extent are interrelated. These factors are:

- The production policy of the existing factories
- Ignorance and attitude of some users
- The lack of deficiency of building codes and standards and the control of compliance to the existing ones.

The Production Policy of the Existing Factories

The general policy of the existing factories seem to be to make the most use of the present aligopoly situation and increase profits by increasing prices as the demand increases rather than investing in the industry and increasing the capacities which would give rise to a competitive industry. Therefore, though the cost to the user is still not high compared to hand bricks, the users and the economy lacks the benefits to be derived from a competitive industry. This situation combined with the facts that many users are unable to calculate the total relevant cost and some users are after making unfair profits, promote the use of resources by inefficient producers. Another aspect of importance to the economy is that the brickyards evade taxation on a great part of the generated income. Also from the brickyard workers' point of view, they are deprived of the rights and the benefits of the factory workers.

Ignorance and Attitude of Some Users

This factor accounts for a greater part of the present distribution of supply in the brick industry than could be considered at the first thought. Though the trend in Istanbul is toward building high apartments, the number of registered one or two story houses alone still constitute 40 percent of the total number of buildings.[1] Most of the owners of these houses receive very little technical help from qualified people. Most of the decisions about the construction are made by the so called foremen who have very little or no knowledge of the properties of available materials. Their main concern is to consume as little as possible on materials. And their experience with the relatively new materials being limited their choice is often the lowest priced material, which they believe will serve the purpose. The price paid for brick constitutes only a part of the wall to be constructed, and, as analyzed in Chapter V, the apparent differences in the price of bricks do not even reflect

[1]Calculated from figures given on p. 25 of July 1967 MBS for the years of 1964-1967.

properly the initial cost of the wall in question. And the additional annual cost of heating, which carries a great significance when the long life of buildings is considered, is completely neglected. However, the factor of ignorance of the user is not confined to the builders of only one or two story houses. The same factor is found to affect the choices of users who build apartments more than a few stories high. Table 5.1 reflects this point clearly.

Another factor which to some extent may be integrated with ignorance, is the high profit considerations of some building merchants who construct buildings for sale by flats. A great amount of housing construction in Istanbul is carried on by these merchants. Their main aim is to reduce the initial cost and increase the profit margin. Since the flats built will be sold, the running costs created by the use of buildings is not relevant for their decision. And the fact that after the walls are plastered and whitewashed the quality of the walling material will not be observed, gives them a freedom of action. Generally under these circumstances for buildings less than five stories of height, it may prove cheaper for the merchants to choose hand bricks if less than 15 krş. is paid per unit of bricks at the construction site. The profit such obtained, however, causes a great waste of fuel as well as some discomfort to the future user of the building and actual reduction in cost as far as the merchant is concerned is less than 2 percent of the total cost of the structure.

The Lack or Deficiency of Building Codes and Standards and the Implication of the Existing Ones

In Turkey, unlike many other countries, the standards which cover bricks do not clearly classify them for different conditions under which they should be used. Bricks are classified and standardized according to their types and sizes and each type is divided into various grades according to their strengths. The decision is left to the engineer to choose the most suitable type and grade for the purpose of use. The main reason behind this is probably the unavailability of some types of bricks in many locations. However, for locations where various types of bricks are or could be available, this situation promotes unfair competition. And a great deal of the construction activity is carried on in locations where various types of bricks are available. It is believed that a classification similar to that of British standards in which all types of bricks are divided into, internal, ordinary, and special qualities would be a helpful guide for the users and the contractors as well as avoiding to some extent, an unfair competition. Under these specifications hand bricks could be classified internal quality and would be used economically in buildings where extra weight does not create additional costs. The factor of consumers' ignorance discussed will evidently reduce the benefits that are to be derived from a full implication of standards. Nevertheless whatever is accomplished will still be valuable.

An aspect of importance that should be included in building codes as one of the main items is a minimum thermal resistivity requirement for exterior walls for various locations in Turkey. This requirement would place some restrictions on only first cost considerations of the building merchants and help the welfare of the citizens.

Due to the reason that before any building may be lawfully constructed plans are submitted to local authorities for permission. The implementation of this requirement could be successfully carried. This requirement would also reduce a great deal of waste of fuel of heating purposes and enable utilization of fuel resources in a productive field.

CHAPTER VII

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. The unbalanced situation of the brick industry in Istanbul today is brought about not by a shortage of supply, but by the fact that since the demand for bricks is increasing at such a high pace and the existing factories are not able to meet this demand, the brickyards, with their flexibility of capacity, take over an undeserved share of the demand. The problem, thus, is not to meet the demand, but to meet it in the way that is best for the economy of the country and the users.

The unbalance of the situation has been brought about not only by the inability of the factories to increase their supplies, but also by the price level policies of the factories and ignorance of some users. Certain remedies could be considered to improve the situation. Recommendations are made in order of preference.

a) A planned aid from the government in terms of loans to the existing factories in order to increase their capacities, as well as promotions in the form of technical aids and loans to convert the more stable brickyards which are located beside raw materials of good quality into modern factories.

b) Investments in this industry by the public sector which would increase the supply and promote competitive pricing.

c) A legislation to restrict factory prices which would encourage factories to enlarge their capacities and make profits on increased sales rather than increased prices.

2. The factories have been observed to have extra capacity during off-season months. Since the factories are unable to keep large stocks they should allow for a seasonal price policy and offer appreciably lower prices in low construction activity periods in order to promote the purchase of factory bricks in advance, thereby increasing production in slack seasons.

3. In Turkey consideration of economy in buildings is generally restricted to reducing the initial cost. This causes an appeal toward the choice of the lower priced materials. The situation is even worsened by the fact that often a distinction between the lower price of a certain material and the lower cost of the functional end product is not properly clear in the minds of many users. In the case of bricks, even if the initial cost of the building is actually reduced by the choice of low price materials, in the long run this often causes an excessive sum on heating which is an enormous personal and national waste of money.

The remedies for this situation are closely related to those discussed in (1). However, in addition, an emphasis on educating the present and future users is also of great importance. Though this is a very broad subject and required long-term planning, some achievements could be obtained by:

a) Establishment of building materials centers where information on the properties, prices and application of available materials would be displayed to users, preferably by The Building Research Institute.

b) Additional building economy courses in technical schools. Also courses to train the foremen.

c) Inclusion of all available materials in the unit price lists of the Ministry of Public Works.

4. The available standards and building codes on bricks and walling materials in no way guide users in choosing the proper materials for various fields of usage. The brick standards must be revised and must classify grades together with the conditions of use. Building codes must include thermal resistivity requirements along with structural requirements. The control of this requirement could be attained by the same agencies which approve structural requirements. This would, to a great extent, eliminate unfair considerations by the building merchants in reducing the initial cost and causing personal and national waste of money.

APPENDIX I

Questionnaire Form for Brickyards

...cari ad: .... Adres: ....
... .

Kapasite: (adet) ....

Yıllık imalat: ....

Fiyat: ....

Malzeme dinlendirilmekte mi? Nasıl?

....

Şekil verme nasıl yapılmakta ....

Pişirme kaç derecede ve hangi yakıt ile yapılmakta? ....

....

İmalatta kullanılan malzeme özelikleri biliniyormu? ....

....

İmalatta katkı maddesi kullanılıyormu? ....

İmal edilen tuglaların özelikleri tayin edilmişmi? ....

Şayet biliniyorsa neticeler ....

Kaç seneden beri imalatta bulunulmakta ? ....

Geçen senelere nisbeten imalatta degişiklik varmı?

İmalat metotlarında ....

Adet bakımından ....

Kaç tip tugla imal edilmekte ? ....

İlerde imalatta degişiklik düşünülmekte midir? Nasıl ? ....

....

Düşünceler ....

APPENDIX II
Questionnaire Form for Users

İnşaat Adresi . . . .

İnşaat cinsi Karkas Yıgma

. . . .

Kapladıgı alan . . . . m^2

Kat Adedi . . . .

Kullanılan tugla cinsi Dolu Delikli Boşluklu

. . . .

Tugla boyutu . . . .

Tuglanın alındıgı yer: . . . .

İmal eden müessese: . . . .

TUGlanın alınış fiatı (nakliye dahil) . . . .

(" hariç) . . . .

Bu tip tugla kullanılmasının sebepleri:

Ucuz oldugu için . . . .

Temini kolay oldugu için . . . .

İşlenmesi kolay oldugu için . . . .

Saglam ve dayanıklı oldugu için . . . .

Daha evvelki inşaatlarda iyi netice alındıgı için. . .

Diger sebepler (izah ediniz) . . . .

. . . .

Tugla yerine başka malzeme kullanılıyorsa (briket veya Ytong) aynı malümat verilebilir.

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