

Unutmaz, Hakan

**Conference Paper**

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38th Congress of the European Regional Science Association: "Europe Quo Vadis? - Regional Questions at the Turn of the Century", 28 August - 1 September 1998, Vienna, Austria

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

*Suggested Citation:* Unutmaz, Hakan (1998) : The analysis of standards in public space and social equipments of public housing units constructed in Turkey, 38th Congress of the European Regional Science Association: "Europe Quo Vadis? - Regional Questions at the Turn of the Century", 28 August - 1 September 1998, Vienna, Austria, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

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# **THE ANALYSIS OF IN PUBLIC AND SOCIAL EQUIPMENTS OF PUBLIC HOUSING UNITS CONSTRUCTED IN TURKEY**

Dr. Hakan UNUTMAZ  
Istanbul Technical University  
Department of City And Regional Planning  
80191 Tapk yla Binas , Taksim, Istanbul, Turkey.

## **1. INTRODUCTION**

Housing is a common problem in Turkey and developing countries. The solution to this problem lies in the rapid and cheap production of housing and this can be achieved by constructing public housing units. Unfortunately, the public housing loans given to same construction cooperations have been used only in the construction of housing blocks but not in the construction of substructural and social facilities.

As a result there, have emerged residences where substructure and social facilities are either insufficient or lacking. This has led the inhabitants of such residences to use the neighboring residences. Consequently, this has resulted in the overuse of the available facilities. The lack of substructure and social facilities obviously affects not only the inhabitants of a specific district but also the municipalities, in terms of city planning.

The problems which have arisen in public housing units that have been constructed in Turkey and developing countries have not been sufficiently dealt with or taken into consideration. The fact that substructure, environmental arrangement and social facility areas have not been dealt with or have not been completed has led to a study in this respect.

This aim of this study is to examine the cost, which is the major cause in the negligence of substructure and social facilities although they do exist in the plan of housing units but are not applied, and to bring out the mathematical ratio of the cost of these facilities to the total unit cost.

### **1.1 PROCEDURE**

In these study, substructure and social facilities which should be planned according to the size of the mass housing unit and to the population size of the public housing units have been considered in accordance to Public Works Law No. 3194 and to the definitions given in No. 2985, 2. Public Housing Law and Applications Regulation, which was valid in 1984 in the Official Gazette. The seven Public housing units used as sampling of the study have over 1000 houses. The spendings of house, substructure, social facilities and environmental arrangement in these units built between the years 1987 and 1992 have been updated according to 1997.

The spendings of house, substructure, social facilities and environmental arrangement in these units built between the years 1987 and 1992 have been updated according to 1994. In these update, the Compound Interest Method has been made use of. The connection in the Compound Interest Method is as follows:

$$F = p ( E+1 ) + p ( E1+1 ) + \dots p ( E_n +1 )$$

The symbols refer to the following:

F= The updated total unit cost

P= The money spent in every year

E= Workmanship and material prices changing according to the years.

After the process of updating, with the results found, the cost per house, and m2, the cost of substructure per house, and per m2, the cost of social facilities per house and per m2,

After the process of updating, with the results found. the cost per house, and m2, the cost of substructure per house, and per m2, the cost of social facilities per house and per m2, and if they exist, the cost of environmental arrangements per house and per m2 have been calculated. After this sequence, Multiple Regression Analysis affecting the total cost, substructure, social facilities and environment arrangement expenses in public housing units. SPSS For Windows Computer programming has been used in this test. The analysis of multiple regression has been made by the method of subsequent smallest squares and STEPWISE method has been used in determine the variants to be entered into the equation.

The values of density, unit base area coefficient which directly affect substructure, social facility and environment arrangement if exists costs have been tested by the process of regression. The results reached have helped to reveal to what extent and under what circumstances substructure, social facility and environment arrangement cost affect the total unit cost.

## **2.THE ANALYSIS OF THE FACTORS WHICH AFFECT COST OF PUBLIC HOUSING UNITS IN TURKEY**

The units chosen for this study conform to the mass housing definition indicated in No: 2985 , 2 nd Public Housing law and Applications Regulation. within the borders of the big city municipalities, units consisting of 1000 houses and having a population of 5000 are considered public housing units. Moreover, the social facilities which ought to exist on this scale according to the same law are defined as in the following.

**Social facilities :** " school, sports center, health facilities, theatre, library, day nursery, cinema, auditorium, swimming pool, police department, post office, place of workshop, playgrounds, environmental arrangement and the like.

"The facilities which make up the social facility cost in the public housing units studied are shown in table 1.

Table 1: The facilities which make up the social facility cost in the public housing units.

PUBLIC HOUSING UNITS	SOCIAL FACILITIES and QUANTITIES
Gaziemir	1 elementary school 4 shopping centers, 2 social facility buildings, 2 nurseries, 1 communication center.
Bahçeşehir	1 elementary school, 1 private, junior high school, 1 shopping center, 1 clinic, 1 communication center, 1 social facility center, game and sports areas.
Ataköy 7-8 District	2 elementary schools, 1 high school sports and game areas.
Ataköy 5. District	2 elementary schools, 1 shopping center, 1 nursery, sports and game areas.
Halkalı 2-3 District	2 elementary schools, 2 junior high schools, 5 shopping centers, 1 social center, 1 health center, 8 nursery.
Eryaman 2-3. District	2 elementary schools, 1 high school 1 shopping center, 1 social center, 1 hospital, 2 nurseries, sports and game areas.
Yahyakaptan	2 elementary schools, , 1 shopping center, 1 hospital, 1 cinema, 1 open pazar area, sports and game areas.

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The substructural facilities that ought to be built in public housing units are defined in the law as in the following. According to this definition,

**Substructure** : " Roads, water electricity, drainage, telephone, central antenna, central communication, central heating and such facilities, and all of the facilities which these require. "The facilities which make up the substructure cost in the seven public housing units studied are Lot arrangement and excavation works, road and parking lot constructions, electricity and clean- used water installations, central heating installations, telephone and satellite television installation works, . garbage disposal system installations.

The information relating to the lot area, number of floors, gross densities, base area coefficients, Floor area coefficients of the public housing units chosen to be used in the Multiple Regression Analysis and the numerical values found by calculating the substructure and social facility cost ( Updated according to the year 1994 ) in the public housing units which were planned according to the above definitions and whose construction contracts were awarded by the Estate Bank, according to the total cost are indicated in the table 2. below.

Table 2: The numerical proportion of the expenses of substructure and social facility constructions in the total costs of the public housing units studied and general information on these units.

Name of unit	number of houses	plan popul.	lot area ( ha )	density person/ ( ha )	base area coeffic.	floor area coeffic.	substru total cost. %	facility total cost %
gaziem.	1962	8800	37.1	220	0.25	2.00	11	7
bahçe behir	2081 ( 446 ) ( 1635)	7500	70.9	122	0.10 0.30	0.30 0.80	12 10	4
ataköy 7- 8.part	2964	12500	48.1	256	0.20	1.50	10	5.5
ataköy 5.part	2993	13450	99.0	427	0.11	1.14	8	9.5
halkalı	4310	18250	66.6	269	0.25	2.16	9.9	7.1
erya- man	4740	21000	100.4	296	0.23	2.16	9.7	4.6
yahya kaptan	4902	22000	62.6	326	0.25	2.05	9	9.2

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Conforming to the table above, Multiple Regression Analysis has been made by using Stepwise Procedure on SPSS For Windows Computer Programme. According to this, Factor affecting the substructure cost per house; An inverse proportion has been found between the substructure cost per house, and the gross density of the unit. In other words, it has been observed that the ratio of substructure costs to the total unit cost declines in public housing units of higher density.

There is a direct proportion between the substructure cost per house and the value of "Base Area Coefficient" . That is, in public housing units where the Base Area Coefficient is high, the cost of substructure in the total cost has gone up, too.

There has been found an inverse proportion between the substructure cost per house and " Floor Area Coefficient ". In other words, as the Floor Area Coefficient goes up, the cost of substructure in the total cost decreases. " Halkalı, Eryaman and Yahyakaptan ' mass housing units can be given as examples to this.

**Factors Affecting the Social Facility Cost Per House:** It has been observed that there is a direct proportion between the social facility cost per house and the density values of the units. Accordingly, in sample units where the density is high, the proportion of social facility cost to the total unit cost is high, too.

It has also been found that the cost of social facilities per house are directly proportional to the Base Area Coefficients of the units. Thus, in the mass housing units whose Base Area Coefficients are high, the proportion of social facilities costs to the total unit cost is high, too. The social facility cost per house is also directly proportional to the Floor Area Coefficients. Thus, It has been observed that mass housing units with higher Floor Area Coefficients also have higher social facility costs in relation to their total cost. As an example to this, Yahyakaptan mass housing unit can be given, where both the Base Area Coefficient and the Floor Area Coefficient are high. In this unit, the ratio of social facility costs to the total cost has proved to be high, too. Another reason for this relationship is that there will be a higher demand for social facilities in units of denser populations. This result is obviously true as the social facility areas will increase in terms of area variety.

It has been observed that there is an inverse proportion between the total cost of the house and the gross density values of the units. According to this, the total cost has proved to decrease in units where the density values go up. It has also been observed that the Base Area Coefficients and the total unit cost are inversely proportional. As a result, as Base Area Coefficient goes up, the total cost decreases.

The ratio between the total cost and the Floor Area Coefficient is inverse, too. Thus, the total cost is lower in public housing units whose Floor Area Coefficient are high. One other factor which causes the change of substructure and social facility costs in terms of total cost is the sloping degree of the lot. Out of the seven units studied, all the units except for " İstanbul Bahçeşehir ", are situated in lots where the sloping degree is between % 5 and % 10. In the lot on which Bahçeşehir is constructed, the sloping degree is over % 15.

This fact has led to an even higher increase in the substructure cost of the parts with two storey villa type houses. It also explains how these facilities affect the cost. The total cost, social facility and substructure costs per m<sup>2</sup> in the units are shown in Table 3.

Table 3: The comperison of the total social facility, substructure and total costs per m2 in the units.

Number of Residences name	Social Facility cost per m2 /USD	Substructure Cost per m2/ USD.	Total Cost Per m2/ USD
Gaziemir	6.3	10.8	96.67
Bahçeşehir	5.1	19.4 10.95	155.85 100.7
Ataköy 7-8 part	7.0	14.62	146.62
Ataköy 5. part	10.95	10.42	116.85
Halkalı	7.42	9.3	93.67
Eryaman	4.05	8.55	87.97
Yahyakaptan	8.62	8.47	57.4

Resurse: Unutmaz., H., " The Study Of Effects Social And Substructural Facilities In mass Housing Units On Total Cost " 1994

### 3.CONCLUSION

It is seen that the substructure and social facilities planned for mass housing units, depending on their quantity and size, will lead to an additional cost in the total cost of the house. As a result of studies on the number of houses in the unit, grass density, the slopin degree of the lot on which the units is situated, Base Area Coefficient and on Floor Area Coefficient, all of which are the outstanding factors affecting substructure and social facility costs directly, the following facts have been concluded.

In two public housing units where the number of houses does not exceed 2000, substructure cost makes up % 11 of the total cost. In the same category, the social facility cost is % 7.1 of the total cost. Only the cost of one house, exluding substructure and social facilities, is % 81.9 of the total cost.

In two public housing units where the number of houses varies between 2900 and 3000, the cost of substructural facilities per house unit makes up % 10.5 of the total cost.

The percentage of the social facilities cost per house to the total cost in the same category is % 9.5. Here, the cost of one house, excluding substructural and social facility costs, is % 80 of the total cost. On the other hand, in three public housing units in which the number of houses is 4000 -5000, the percentage of substructural facility cost per house to the total cost varies between % 9 and % 9.9.

While the substructure cost constitutes % 9.9 of the total cost in a unit with 4000-4500 houses, this percentage has fallen down to % 9.7 in a unit with 4500-4750 houses. In a housing unit where the number of houses varies between 4750-5000, the cost of substructural facilities is % 9 of the total cost of unit the unit.

Thus, it can be said that as the number of houses in a unit increases, the percentage of substructure cost the total unit cost decreases.

In the above mentioned category, the ratio of social facility costs to the total cost varies between % 4.6 and % 9.2. The informations in table 1 show that the social facilities in every unit differ in number when compared with each other.

" Eryaman Housing Complex " can be taken as an example here. This complex has a lower quantity of social facilities as compared to " Halkalı " and " Yahyakaptan " public housing complexes which are of the same dimension as itself. This has resulted in a lower ratio of the social facility cost to the total unit cost, which is % 4.6. This ratio is " Yahyakaptan Complex ' which had been planned with almost the same dimensions, being % 9.2, is much higher.

In two of three units in this category, landscape expenses have separately been determined. These expenses constitute % 5.1 - % 6 of the total cost. In Yahyakaptan Public Housing Complex, where the gross density is a population of 326 per hectare, substructure cost is the lowest portion of the total cost. One reason for this is that the Floor Area Coefficient value as well as the density value is higher than those of the other units. Another reason is that this complex has a highre house capacity with 4902 houses than the other housing units. Thus its substructure expenses constitute as lower portion of the total unit expenses.

The Multiple Regression Analysis process which has been used to bring out the elements affecting the ratio of substructure and social facility costs to the total cost has indicated the fact that as the density of units increases, the ratio of substructure facility costs to the total cost decreases. On the other hand, since the quantity and qualty of social facilities would increase when the population of the units increases, the costs of these facilities would naturally go up, too. This inevitably leads to a higher ratio of social facility expenses in the total unit cost.

According to the results of the Regression Analysis, in the public housing units with a lower Base Area Coefficient, the costs of substructure and social facilities decrease when compared to the units which have a higher Base Area Coefficient. However, in the units where the Floor Area Coefficient is high, substructure and social facility expenses are lover than those of units with a lower Floor Area Coefficient. In " Eryaman, Yahyakaptan and Halkalı Public Housing Units ", since their Floor Area Cofficients are higher than those of the other units, the costs of substructure and social facilities prove to be lower when compared to the other four public housing units.

This study has shown that public housing units consisting of fewer than 1000 houses are not financially appropriate. As an example to this, Istanbul Bahçeşehir Public Housing Complex which has a capacity of 2081 houses can be given. One part of this complex consist of 446 villa type hoses and in this part the substructure cost makes up % 12 of the total unit cost. But in the maining part which built on the same type of land lot and which consist of 1635 apertmant houses, this ratio is only % 10 of the total unit cost. A difference of % 2 in the substructure cost would naturally affect the total cost and thus the total cost would go up.

According to the results given above and interms of city planning, in a housing complex of minimum 1000 houses- as accepted by both the currently valid No:2985, Second Public Housing Law and Applications Regulation in Turkey and No: 3194 Housing and Construction



Law, the requirements to be met in order to reduce the unit cost are indicated below: Provided that first class construction materials are used, for a unit of 1000 houses.

- 1.The most of appropriate gross density is 326-427 person/hectar.
- 2.The most of appropriate Base Area Coefficient is 0.10 - 0.15.
- 3.The most appropriate Floor Area Coefficient is 2.05 - 2.18,
4. The most appropriate slope degree of area is % 5 - % 10.
- 5.The average floor number is 8 - 11.

The research done has proved the above mentioned standards. As Long as these standards are conformed to, the substructural facility cost will make up % 9 - % 9.9 and social facility cost will make up % 9.5 of the total cost.

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