COST ESTIMATION OF HOUSING PROJECTS BY FUNCTIONAL AREAS

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FOR
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Approval of the Graduate School of Natural and Applied Sciences

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ABSTRACT

COST ESTIMATION OF HOUSING PROJECTS BY FUNCTIONAL AREAS

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Good conceptual cost estimates is one of the most important factors affecting the project success. Investment decisions taken and budget preparations are performed from the results of the conceptual estimates. Also, the most difficult cost estimation is the early estimates where there is very limited information.

This thesis provides a model for the cost estimation of the housing projects at the conceptual stage, considering not only the total area of the construction, but also considering fractional areas, as kitchen area, bathroom area, living room area and etc. Moreover, model outputs a range of costs considering quality of the construction instead of a point estimate which allows investors to see the possible costs of the project by their choice of luxury.

Keywords: Cost Estimation, Conceptual Estimates, Modeling of Cost Estimation, Early Estimates, Cost of Housing Projects

ÖZ

VİLLA PROJELERİNİN YAKLAŞIK MALİYETLERİNİN HESAPLANMASI

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Projelerin başarılı olmasındaki en önemli faktörlerden biri yaklaşık maliyetlerin iyi hesaplanmasıdır. Yaklaşık maliyet hesaplarının sonuçlarına göre yatırım kararları alınır ve inşaat bütçeleri bu sonuçlara göre hazırlanır. Ayrıca maliyet hesapları arasında en zoru yaklaşık maliyet hesaplamalarıdır çünkü bu esnada proje hakkında çok az bilgi bulunmaktadır.

Bu tezde, yalnızca inşaat alanının büyüklüğüne bağlı olmaksızın, toplam mutfak alanı ve banyo alanı gibi faktörleri de göz önüne alarak villa projelerinin yaklaşık maliyetlerinin hesaplanması için bir model oluşturulmuştur. Ayrıca model bir averaj değer yerine inşaatın kalitesine bağlı olarak değişen bir maliyet aralığı vermektedir. Bu sayede yatırımcılar kalite seçimlerine göre proje maliyetlerinin nasıl değişebileceğini görebilmektedirler.

Anahtar Kelimeler: Maliyet Hesaplaması, Yaklaşık Maliyet, Maliyet Hesaplama Modellemesi, Villa Projelerinin Maliyeti

Beni Seven ve Başarımda Payı Olan Herkese

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CHAPTER 1

GENERAL INFORMATION ABOUT COST ESTIMATION

The most important property of a project is its cost, namely its budget. As a result of benefit cost analysis, decision about whether to realize the project or not is taken. This decision mainly depends on estimated cost of the project and cash flow predictions. From civil engineering point of view civil engineers should focus on the construction cost. Generally, most of the project cost consists of construction cost.

Material, equipment, manpower, transportation, design and overhead costs make up the construction cost. Construction cost of a single project depends on many factors such as market conditions, productivity, contract properties and etc. Since these factors vary significantly, cost estimation is very hard to make without some variance from actual cost. Also, cost estimation is a very important process since investment decisions based on it, and budget preparations are performed as a result of it. Project success is directly related with the success of cost estimation; how well the cost estimate predicts the actual cost.

Cost estimate's accuracy mainly depends on the information that the estimators have. After the detailed design is completed, accuracy of cost estimate increases significantly. But, during feasibility stage where scope definition is limited, accuracy of estimate is mostly controlled by quality of the estimator, technique used, time given to the estimator, the economic conditions of the country; whether it is stable or not, and the type of the construction. As can be seen in the figure 1.1, influence of the estimator's skills on the accuracy of the cost estimates tends to reduce with the increase of the scope definition. While the construction proceeds, detailed drawings will be obtained and unknown factors about the project will be reduced, which in turn makes the estimation easier and more accurate. As a result, it can be seen that

the most difficult estimations are the conceptual estimations where there is little information about the project.

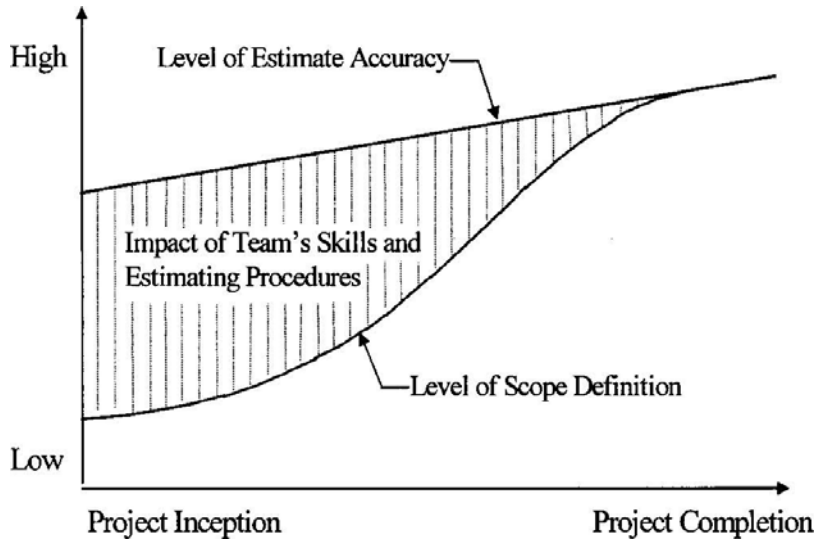

Figure 1.1. Estimate Accuracy [1]

In the early stages of the projects, estimators should have a proper technique to estimate the cost. Commonly used, and a simple technique is to use data of recent, similar constructions and obtain an average value for a unit area and then estimate the cost of the new project by considering the total area. For example, a company constructed 5 residential buildings and average cost was 300YTL/m^2. So, if a new residential building of 1000 m^2 is to be constructed, initial estimation for the project can be 300,000 YTL. Generally, while using this estimation technique, there is little information about the project. Only one factor; construction area is known. As can be predicted easily, this unit cost can vary significantly with the level of luxury, number of floors, location of the construction, time etc. However, in spite of all these disadvantages, the cost of a project can be estimated at the early stages of the project, by using this method. Since, detailed information about the project is not known, any model which requires more data than estimators have, can not be used.

Another method is to use regression analysis to predict the cost of a project considering significant variables. In this method, data from past projects are collected. (Data of some expected significant variables and cost) A regression analysis is performed to find a model to use for conceptual estimating. The significant variables are found considering p values. P values show the contribution of variable to the model. After ignoring insignificant variables, final model is performed considering R^2 and R^2 adjusted values, which show how well the model is, for the given data. In this technique, reliance of the past data is very important since final model is completed using this data. If the data is inadequate, results will perform poor estimates. Another disadvantage is that, estimators should have necessary data to input to the model to use it. In other words, for example if model requires input of type of heating system, and if there is no information about the heating system that will be used, this model can not be used. However, if the model's data are reliable and close to the properties of the project that will be constructed, this method can be used to predict the cost. This method can be used when information about the project that will be inputted to the model is known.

Another method is to use neural networks for conceptual cost estimation. As in regression analysis input of several variables and an output is defined; cost. The historical data is given and neural networks relate input to the output. In this model too many variables must be avoided and it is preferable to use this model with the results of regression analysis. By this way, only the significant variables will be used in neural network model. If too many variables were defined, results will be inaccurate. As in regression analysis, this method needs historical data and also the reliability of data affects the results.

After some general information about cost estimation, treatment to the conceptual cost estimation from the construction industry in Turkey should be focused. Cost estimation is performed for infrastructure and big projects but it is not performed for residential constructions. However, huge part of constructions in Turkey is

residential constructions. Also, skillful and well educated people in this area are limited. Most constructions are started without any cost estimation, planning and budget preparations. As a result, poor project results are obtained in which sometimes even construction is not completed. Results of such projects are, wasted development effort, time and money. Sources of the country should be well organized and should be used more efficiently.

Another important point is that generally cost accounting is not performed for residential constructions and historical data about the costs of the projects is very hard to find, reliance is questionable and this data is in limited number.

CHAPTER 2

RECENT RESEARCHES

2.1 2005 UNIT PRICE ANALYSIS OF CONSTRUCTION WORKS [2]

This book combines all the information that published every year by the Ministry of Public Works and Settlement, about the cost calculations of the construction works. Book has same layout and table of contents but it is updated every year by considering law and price changes.

In Ünal Akçalı's study, cost analysis of specific construction works are completed using Ministry of Public Works 2005 unit prices. Unit prices of most of the construction work items were analyzed considering material, manpower, transportation costs and wastes. These analyses are very useful to predict the cost of the projects. However, unit prices of work items can be used for cost estimation after the completion of the quantity take-off. Unit price analysis of some work items were used for the preparation of the cost model in this thesis.

Moreover, for conceptual cost estimation some average unit area prices were prepared for some construction types as can be seen in Table 2.1 [2]. These costs per m^2, are very useful to predict the cost of the projects at the early stages of the feasibility study, however, accuracy is limited. These costs are average costs to be used in every region of Turkey. However, costs of labor, materials and etc. change significantly from city to city. Also, values are average and there is no information about possible variances. In other words, point estimation was used instead of range estimation.

Table 2.1 Cost per Unit Area w. r. to Building Types

SINIF	GRUP	YTL/m2
I	A	51
	B	89
II	A	141
	B	193
III	A	315
	B	359
IV	A	406
	B	448
	C	539
V	A	668
	B	809
	C	924
	D	1,103

These unit area prices are published every year by Ministry of Public Works and Settlement and this year with the name "2005 Yılı Yapı Yaklaşık Maliyeti Hesabında Kullanılacak Birim Maliyet Değerleri" Information about the classes and groups of the structures can be found below [2]. Estimators choose their building type from the list and calculate the estimated price by multiplying unit area cost with the total cost of the construction.

I.SINIF YAPILAR

A GRUBU YAPILAR

• 3 m yüksekliğe kadar kagir ve betonarme istinat ve bahçe duvarları
• Basit kümes ve tarım yapıları
• Baraka veya geçici kullanımı olan küçük yapılar
• Mevcut yapılar arası bağlantı-geçiş yolları
• Yardımcı yapılar (Müştemilat)

• Gölgelikler-çardaklar
• Üstü kapalı yanları açık teneffüs, oyun gösteri alanları
• ve bu gruptakilere benzer yapılar.

B GRUBU YAPILAR

• Basit padok, büyük ve küçük baş hayvan ağılları
• Su depoları
• İş yeri depoları
• ve bu gruptakilere benzer yapılar.

II.SINIF YAPILAR

A GRUBU YAPILAR

• Kuleler, ayaklı su depoları
• Palplanj ve ankrajlı perde ve istinat duvarları
• Kayıkhane
• ve bu gruptakilere benzer yapılar.

B GRUBU YAPILAR

• Seralar
• Pnömatik ve şişirme yapılar
• Hangar yapıları
• Tek katlı ofisler, dükkan ve basit atölyeler
• Semt sahaları (Müştemilatlı)
• Tarım ve endüstri yapıları (Tek katlı prefabrike binalar, tesisat ağırlıklı ağıllar, fidan yetiştirme ve bekletme tesisleri)

• Yat bakım ve onarım atölyeleri, çekek yerleri
• Jeoloji, botanik ve tema parkları
• Mezbahalar
• ve bu gruptakilere benzer yapılar.

III.SINIF YAPILAR

A GRUBU YAPILAR

• Okul ve mahalle ölçeği spor tesisleri (Temel eğitim okullarının veya işletme ve tesislerin spor salonları, jimnastik salonları, semt salonları)
• Katlı garajlar
• Hobi ve oyun salonları
• Ticari bürolar (üç kata kadar-üç kat dahil - asansörsüz, kalorifersiz)
• Alışveriş merkezleri (Semt pazarları, küçük ve büyük hal binaları, marketler)
• Basımevleri, matbaalar
• Soğuk hava depoları
• Konutlar (dört kata kadar-dört kat dahil - asansörsüz, kalorifersiz)
• Benzin istasyonları,
• Kampingler
• Küçük sanayi tesisleri (Donanımlı atölyeler, ticarethane, dükkan, imalathane, dökümhane)
• Semt postaneleri
• ve bu gruptakilere benzer yapılar

B GRUBU YAPILAR

• Kreş-Gündüz bakımevleri
• Otel ve moteller (1 ve 2 yıldızlı oteller, 2. sınıf moteller)
• Entegre tarım ve endüstri yapıları

• İdari binalar (İlçe tipi hükümet konakları, vergi daireleri)
• Gençlik Merkezleri
• Belediyeler ve çeşitli amaçlı kamu binaları
• Lokanta, kafeterya ve yemekhaneler
• Temel eğitim okulları
• Küçük kitaplık ve benzeri kültür tesisleri
• Jandarma ve emniyet karakol binaları
• Sağlık tesisleri (Sağlık ocakları, kamu sağlık dispanserleri, sağlık evleri, sağlık merkezleri)
• Ticari bürolar (Kaloriferli ve asansörsüz veya kalorifersiz ve asansörlü)
• Halk evleri
• Pansiyonlar
• 150 kişiye kadar cezaevleri
• Fuarlar
• Sergi salonları
• Konutlar (asansörlü ve/veya kaloriferli)
• Marinalar
• Gece kulübü, diskotekler
• İtfaiye kurtarma istasyonları
• Misafirhaneler
• Büyük çiftlik yapıları
• ve bu gruptakilere benzer yapılar

IV. SINIF YAPILAR

A GRUBU YAPILAR

• Özelliği olan büyük okul yapıları (Spor salonu, konferans salonu ve ek tesisleri olan eğitim yapıları)
• Poliklinikler ve benzeri sağlık yapıları (Hastaneler hariç)

• Liman binaları
• İl tipi hükümet konakları (Büyük idare binaları ve büyükşehir belediye binaları)
Yüksek okullar ve eğitim enstitüleri
• Ticari Bürolar (Asansörlü ve kaloriferli)
• 150 kişiyi geçen cezaevleri
• Kaplıcalar, şifa evleri v.b. termal tesisleri
• Rehabilitasyon ve tedavi merkezleri
• İbadethaneler (Dini yapılar 1000 kişiye kadar)
• Sanayi tesisleri ve fabrikalar (Fen ve sanat yönünden nitelikli)
• Aqua parklar
• Müstakil spor köyleri (yüzme havuzları, spor salonları ve stadlar)
• Özellikli müstakil konutlar (Villalar, teras evleri, dağ evleri, kaymakam evi)
• Apartman tipi konutlar (Bina yüksekliği 21.50 m.'yi aşan, asansörlü ve/veya kaloriferli)
• Yaşlılar Huzurevi, kimsesiz çocuk yuvaları, yetiştirme yurtları
• Büyük alışveriş merkezleri
• ve bu gruptakilere benzer yapılar

B GRUBU YAPILAR

• İş Merkezleri
• Araştırma binaları ve laboratuarlar
• Metro istasyonları
• Stadyum, spor salonları ve yüzme havuzları
• Büyük postaneler (merkez postaneleri)
• Otobüs terminalleri
• Satış ve sergi binaları (showroomlar)
• Eğlence amaçlı yapılar (çok amaçlı toplantı, eğlence ve düğün salonları)
• Banka Binaları
• Otel ve moteller (3 ve 4 yıldızlı oteller ile 1.sınıf moteller)
• Normal radyo ve televizyon binaları

• Özelliği olan genel sığınaklar
• ve bu gruptakilere benzer yapılar

C GRUBU YAPILAR

• Hastaneler (150 yatağa kadar)
• Büyük kütüphaneler ve kültür yapıları
• Bakanlık binaları
• Yüksek öğrenim yurtları
• Arşiv binaları
• Büyük Adliye Sarayları
• ve bu gruptakilere benzer yapılar

V. SINIF YAPILAR

A GRUBU YAPILAR

• Radyo-TV istasyonları
• Özelliği olan askeri yapılar ve orduevleri
• Büyükelçilik yapıları, vali konakları ve 600 m2 üzerindeki özel konutlar
• Borsa binaları
• Üniversite kampüsleri
• Alışveriş kompleksleri (İçerisinde sinema, tiyatro, sergi salonu, kafe, restoran, market bulunan)
• ve bu gruptakilere benzer yapılar

B GRUBU YAPILAR

• Kongre merkezleri
• Müze, sergi, kütüphane kompleksleri
• Olimpik spor tesisleri-hipodrumlar

• Bilimsel araştırma merkezleri, AR-GE binaları
• Havaalanları
• İbadethaneler (1000 kişinin üzerinde)
• ve bu gruptakilere benzer yapılar

C GRUBU YAPILAR

• Hastaneler (150 yatağın üstündeki hastaneler ve özelliği olan ihtisas hastaneleri)
• Üst donanımlı kompleks oteller ve tatil köyleri (5 yıldızlı)
• Büyük radyo ve televizyon binaları
• ve bu gruptakilere benzer yapılar

D GRUBU YAPILAR

• Opera, tiyatro, bale yapıları, konser salonları ve kompleksleri
• Restore edilecek yapılar ve tarihi ve eski eserler niteliğinde olup, yıkılarak orijinaline uygun olarak yapılan yapılar
• ve bu gruptakilere benzer yapılar

House (villa) constructions are in the 4^{th} class and group A structures. As can be seen on Table 2.1, for these structures unit area price is 406 ytl/m^2. Results of the thesis study will be compared with this unit area cost.

In the same book [2] another study was performed about the amount of some materials for the unit construction of residential houses. Results like, 0,380 m^3 concrete for 1m^2 of house construction and 34kg of reinforcement for 1m^2 of house construction were obtained. These are very useful to predict the required amount of materials. It will be better to note that, probably material amounts vary less than the unit costs because cost is affected by much more factors than the required material amounts. Examples of these factors can be location, degree of luxury, quality and etc.

2.2 CONCEPTUAL COST ESTIMATION OF BUILDING PROJECTS WITH REGRESSION ANALYSIS AND NEURAL NETWORKS [3]

In this study performed by Rıfat Sönmez, historical data of 30 continuing care retirement community projects were used to perform a model using regression analysis for the construction of these types of projects. Continuing care retirement projects are generally a mix of residential, health center and commons buildings and some may also have structured parking. [3]

Following variables were considered for the regression analysis;

1. Construction Year (T)
2. Construction Location (L)
3. Total Building Area (A)
4. Combined percent area of Health Center and Commons (H)
5. Area per Unit (U)
6. Number of Floors (F)
7. Percent Area of Structured Parking (S)

All the variables were included in the first model and the variable with the maximum p value was deleted from the model and a new model was performed considering other variables. P values show the significance of the variable for the model. Generally a p value of smaller than 0,1 shows that variable is significant for the model. After, the 3rd analysis a final model was developed. In Table 2.2, properties of the model and the steps for achieving the final model can be seen.

Table 2.2. Regression models [3]

Model	Independent variables	R^2	Variable corresponding to the coefficient with the highest *P* value	*P* value of the coefficient
RM1	*T*, *L*, *A*, *H*, *U*, *F*, *S*	0.951	*S*	0.663
RM2	*T*, *L*, *A*, *H*, *U*, *F*	0.950	*F*	0.383
RM3	*T*, *L*, *A*, *H*, *U*	0.949	*L*	0.110

Final model contains 5 variables and is a linear model. As can be seen on table 2.1, final model contains location factor. Location factor has a p value of 0.11. As stated earlier, generally variable having a p value smaller than 0.1 is considered as a significant variable for a regression model. However, since p value of the location factor (L) is close to 0.1, Rıfat Sönmez considered this variable as significant and put it in the final model.

After the regression model, a neural network model was developed to see how well the regression model is. As considering both two models, the impacts of variables on the cost per unit area were obtained, which you can see on the following figures.

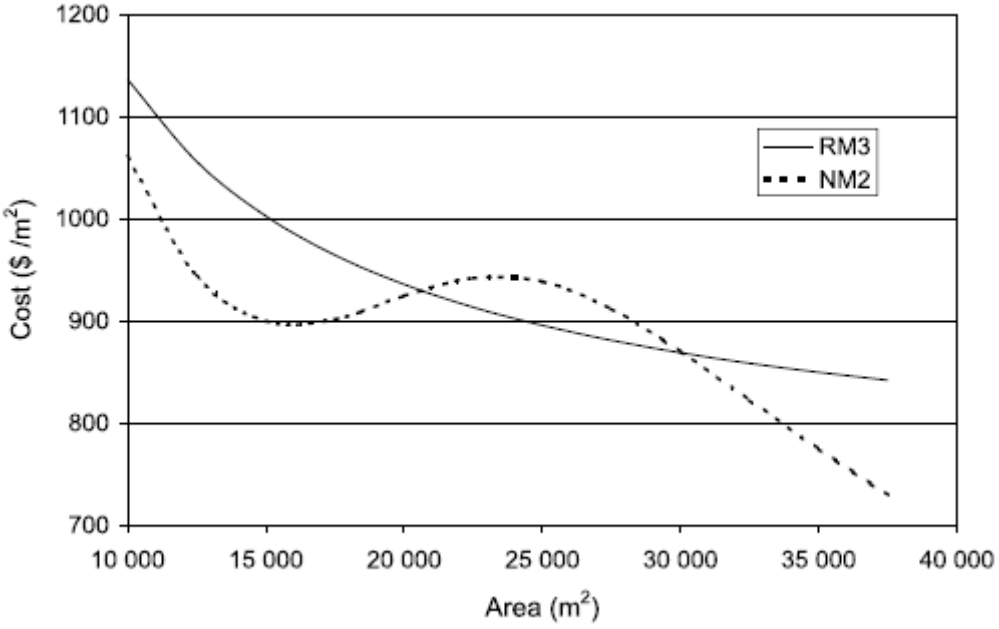

Figure 2.1 Impact of building area on cost per unit area [3]

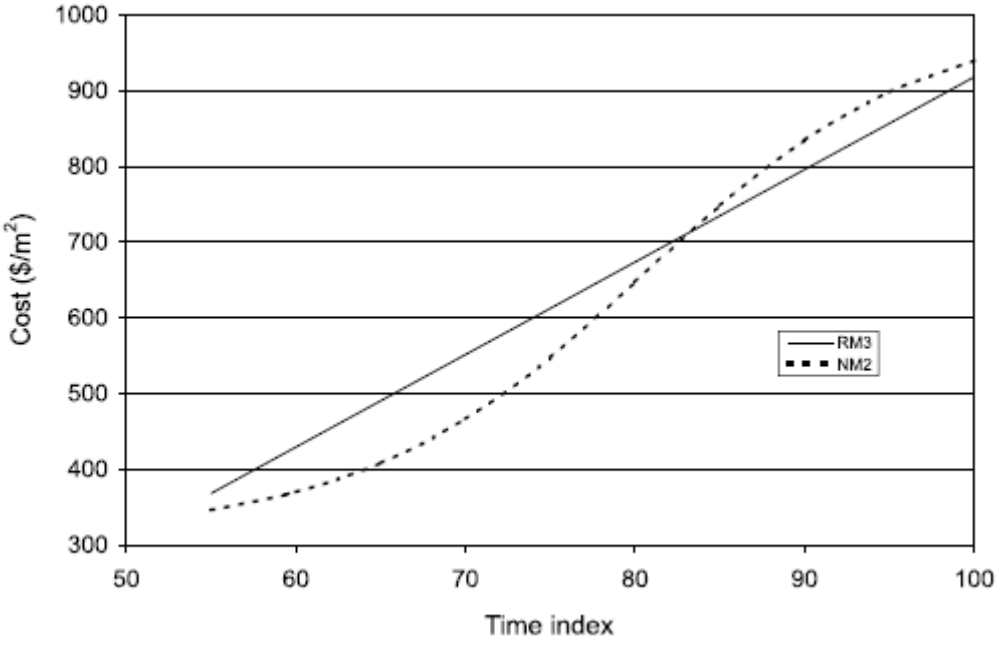

Figure 2.2 Impact of time index on cost per unit area [3]

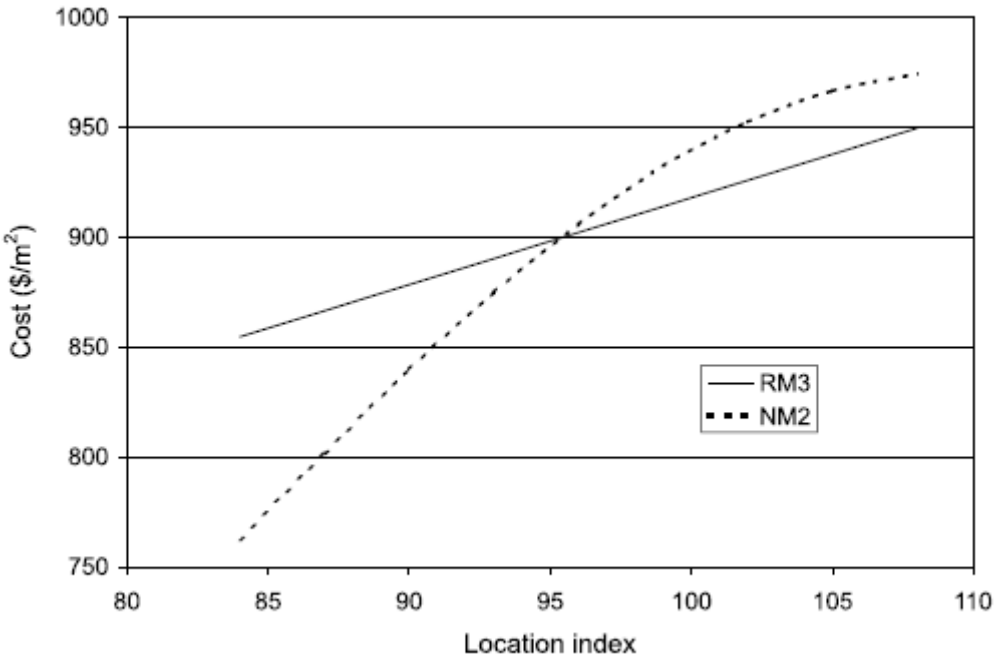

Figure 2.3 Impact of location index on cost per unit area [3]

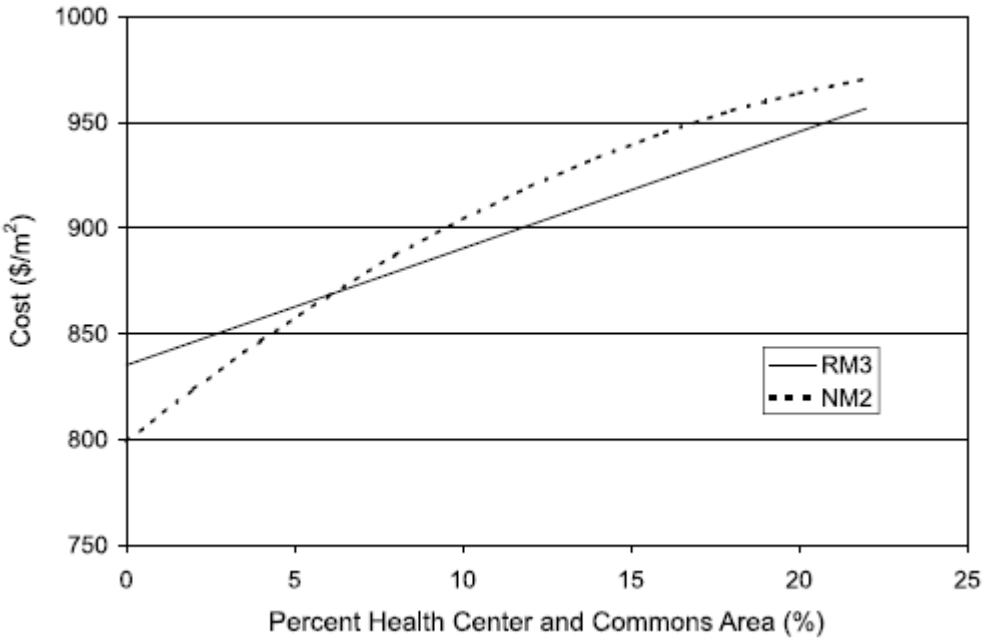

Figure 2.4 Impact of percent health center & commons area on cost per unit area [3]

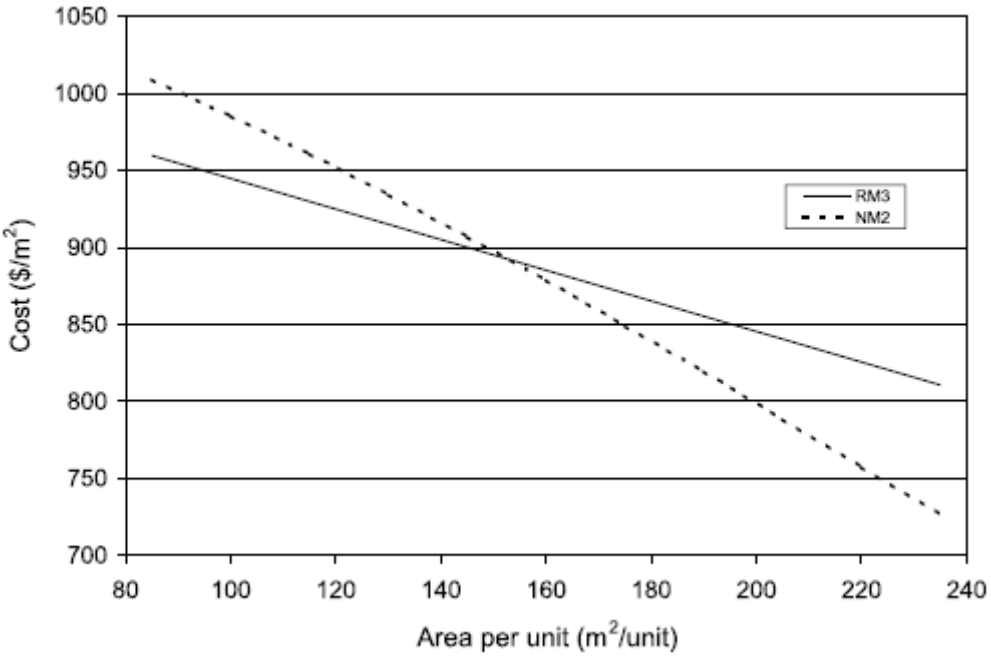

Figure 2.5 Impact of area per unit on cost per unit area [3]

It can be seen on the previous figures that impact of variables on the unit area cost, has same trend both for neural network model and the regression model. As a result, it was shown that regression model is a good model to predict the cost of such projects.

For commenting on the results of this study, it can be said that the model developed is a good model but it can be only used for continuing care retirement projects that will be constructed in United States of America. This model can not be used for any residential constructions in Turkey.

2.3 HOW MUCH TO BUILD ON YOUR LOT [4]

This research was made to be used for home construction cost estimation. A program was written to be put in the website (building-cost.net) and home construction cost estimation is performed by considering variables such as;

1. Materials
2. Design
3. Size
4. Shape
5. Quality
6. Design Features
7. Heating & Cooling type
8. Location

Program developed by Craftsman Book Company asks questions about the housing project that will be built. Following questions are asked;

1. How many corners does this home have?

Proper answer is given. Choices are four, six, eight and ten or more corners

2. What is the total living area of this house?

Total living area is inserted.

3. What is the quality class of this home?

It asks about the quality of the parts of the construction. It gives a classification which class 1 means the best quality and class 4 means the worst. Appropriate class is chosen for the following groups;

   a. Foundation
   b. Exterior Walls
   c. Framing
   d. Exterior Finish
   e. Windows and Doors
   f. Roofing
   g. Interior Finishes
   h. Flooring
   i. Bathrooms
   j. Kitchen
   k. Plumbing

4. Is there an attic, balcony, basement, garage or exterior porch?

Whether these are present or not and the area for each of them if they are present are inputted.

5. Where is this home being built?

Homes, building outside the metropolitan area tend to cost less and also homes built in housing tracts by merchant builders tend to cost less. [4] Proper answer given.

6. What heating and cooling does this house have?

Proper answer is chosen from the menu. Menu has answers like circulating hot water system or circulating cold water system.

7. How many fireplaces in this house?

Number of the fireplaces is entered and also proper type of the fireplaces is chosen from the menu.

8. Where this house is being built?

State, where the house will be built, is selected.

Considering answers, program in the web site prepares a report for the cost of the house construction. It divides the costs as material, labor and equipment. Also, instead of giving only the total cost of the project, it gives costs for each work item like, excavation cost, door cost, garage cost and etc. An example cost report can be found in Table 2.3. The house, used for the preparation of this report, has a total area of 4000 ft^2 (~372 m^2), 6 corners, and will be constructed in Florida. Total estimated cost was found as $ 354,165. So, estimated unit area cost for this house is 952 $/$m^2$.

This computer program is very useful to predict the cost of house constructions. By giving limited input about our project, very detailed cost estimation will be obtained. There are some specific questions about the project that estimators may not have at the feasibility stages. In that case, these specific questions can not be answered. However, program will prepare a report considering only the answered questions. This is a very special feature of the program. By this way it can be used in every

stages of the cost estimation. As can be predicted, accuracy of the estimate increases with the increase in the number of questions answered.

First disadvantage of using this program is that, instead of range estimation it gives a point estimate. Moreover, program should ask for the area of the kitchen, living room and other parts of the house to predict the cost, since unit area costs for different type of rooms may vary significantly. By this way, more accurate results would have been obtained. Commenting on the results is impossible since the market conditions in the U.S.A are not known.

However, cost of work items can be investigated so that it can give some idea about the work items that tend to costs higher. Work items were rearranged according to their total costs as can bee seen in Table 2.4. Masonry frame and heating and cooling system costs are the biggest costs in this example report.

Table 2.3. Example Cost Report by Building-Cost.net [4]

Item Name	Material	Labor	Equipment	Total
Excavation	--	3,054.00	929.00	3,983.00
Foundation, Piers, Flatwork	7,053.00	10,347.00	1,890.00	19,290.00
Rough Hardware	689.00	1,012.00	186.00	1,887.00
Masonry Frame	23,518.00	30,219.00	1,990.00	55,727.00
Insulation	4,271.00	2,723.00	--	6,994.00
Exterior Finish	12,141.00	6,763.00	977.00	19,881.00
Exterior Trim	822.00	1,208.00	221.00	2,251.00
Doors	2,084.00	1,631.00	--	3,715.00
Windows	3,590.00	2,276.00	--	5,866.00
Finish Hardware	347.00	272.00	--	619.00
Garage Door	984.00	374.00	--	1,358.00
Roofing, Flashing, Fascia	9,536.00	7,460.00	--	16,996.00
Finish Carpentry	1,266.00	5,946.00	--	7,212.00
Interior Wall Finish	6,075.00	8,750.00	--	14,825.00
Painting	3,630.00	7,904.00	--	11,534.00
Wiring	3,685.00	6,489.00	--	10,174.00
Lighting Fixtures	2,763.00	811.00	--	3,574.00
Flooring	2,715.00	3,593.00	--	6,308.00
Carpeting	5,401.00	1,797.00	--	7,198.00
Bath Accessories	1,338.00	768.00	--	2,106.00
Shower & Tub Enclosure	854.00	668.00	--	1,522.00
Countertops	2,583.00	2,019.00	--	4,602.00
Cabinets	8,493.00	2,491.00	--	10,984.00
Built In Appliances	4,133.00	538.00	--	4,671.00
Plumbing Rough-in and Connection	3,878.00	8,784.00	612.00	13,274.00
Plumbing Fixtures	7,878.00	2,328.00	--	10,206.00
Heating and Cooling Systems	17,014.00	25,520.00	--	42,534.00
Unit Heating and Cooling	--	--	--	--
Fireplace and Chimney	527.00	790.00	--	1,317.00

Table 2.3 (continued). Example Cost Report by Building-Cost.net [4]

Subtotal Direct Job Costs	**$137,268.00**	**$146,535.00**	**$6,805.00**	**$290,608.00**
Final Cleanup	--	1,428.00	--	1,428.00
Insurance	9,998.00	--	--	9,998.00
Permits & Utilities	6,070.00	--	--	6,070.00
Plans & Specs	1,428.00	--	--	1,428.00
Subtotal Indirect Job Costs	**$17,496.00**	**$1,428.00**	**--**	**$18,924.00**
Contractor Markup	44,633.00	--	--	44,633.00
Total Cost	**$199,397.00**	**$147,963.00**	**$6,805.00**	**$354,165.00**

Table 2.4 Example Report Item Costs Listed from Highest Cost ($)

Item Name	***Total***
Masonry Frame	55,727
Heating and Cooling Systems	42,534
Exterior Finish	19,881
Foundation, Piers, Flatwork	19,290
Roofing, Flashing, Fascia	16,996
Interior Wall Finish	14,825
Plumbing Rough-in and Connection	13,274
Painting	11,534
Cabinets	10,984
Plumbing Fixtures	10,206
Wiring	10,174
Finish Carpentry	7,212
Carpeting	7,198
Insulation	6,994
Flooring	6,308
Windows	5,866
Built In Appliances	4,671
Countertops	4,602
Excavation	3,983
Doors	3,715
Lighting Fixtures	3,574
Exterior Trim	2,251
Bath Accessories	2,106
Rough Hardware	1,887
Shower & Tub Enclosure	1,522
Garage Door	1,358
Fireplace and Chimney	1,317
Finish Hardware	619
Subtotal Direct Job Costs	**290,608**

CHAPTER 3

GENERAL INFORMATION ABOUT THE THESIS STUDY

3.1 INTRODUCTION

This thesis provides a model for the cost estimation of the housing projects at the conceptual stage, considering not only the total area of the construction, but the kitchen area, bathroom area, living room area, entrance and corridors area, terrace area, balcony area, and bedroom area.

While estimators use a model for their cost estimation, they consider two factors. First, whether they have the required information to input to the model or not (in other words whether they can use the model or not) Secondly, whether the model gives accurate results or not. This model will provide both of the factors for the cost estimation of the housing projects.

This model will be very simple. Required inputs are only the areas of several room types of the house project. This data can be obtained even at the early stages of the feasibility studies. Secondly, it will provide better estimations than any model which considers only the total area of the construction.

Moreover, this model is only for villa type housing constructions. For villa type housing constructions, results of this model will be more accurate than results of any other model which is for several types of constructions. Any model, which is specific for some type of construction, is more accurate for that type of constructions.

This model is for 2 story house constructions in Ankara region. It will give estimations in the safe side for 3 or more story house constructions and can be used for these projects. The reason behind this is explained below;

For example, there are two similar projects with the same design, but first one has 2 stories and the other has 3 stories. First one is 200 m^2 and the second is 300 m^2. Roof covering costs will be same for these projects. Since the 2 story projects total area is lower, cost of roof per m^2 will be higher for that one. The case will be the same for the costs per m^2 of work items like entrance door cost, roof framing cost and etc. As a result, when the costs of activities per m^2 will be added, it will be seen that first project will cost more in unit area basis. As a conclusion, it can be said that when the number of floors increases unit costs per m^2 will decrease. So, a model, which was developed for 2 story housing constructions, for a project which has 3 stories, will overestimate the cost.

However, it should be reminded that this model should not be used for residential building constructions where the total area of construction is much bigger than the total area of house constructions. However, it can give some idea about the costs even for residential building constructions. But, probably estimates will be higher when this model will be used for building projects. As the total area of construction increases, unit area cost tends to decrease as shown on figure 2.1 [3]. It can be said that models result will not be accurate for big residential projects.

This research is performed by considering market and specific conditions in Ankara. Also, data used reflects the general quality conditions in Ankara. Extreme cases were avoided. However, this model can be used for other cities in Turkey. In that case possible variances can occur due to market and climate conditions. Market conditions directly affect the cost whereas specific conditions including the climate conditions, soil properties, earthquake region etc. can affect the required concreting, excavation, foundation and also the insulation.

It should be noted that results will be without value added tax and the profit of the contractor. This study is basically for the contractors, so it is better not to add profit for the contractors. Also, value added tax should be regarded separately and it is not a cost in accounting point of view. However, VAT of 18% and contractors profit around 25% can be added to the results for ordinary people interested in construction costs for their house projects.

Results of the model should be used during feasibility stage to have an idea about the cost and to decide on whether to invest, or not. After detailed drawings are prepared, quantity take off should be performed and detailed estimates should be used for the further budget preparations. The aim of this research is to have a more accurate estimate for 2 story villa constructions, instead of using Ministry of Public Work's [2] generalized unit prices for the cost estimates.

Another use of the model will be to use it before the preparation of the architectural drawings. For example, a contractor can have a specified limit of budget for the housing project. To remain within this budget, contractor can decide on the total area of this project and also, can decide on the distribution of the areas of the several types of rooms. For example, total area of the construction can remain constant but, to remain in the budget contractor can decrease the area of the kitchen and increase the area of the bedrooms to have lower overall cost. (It is assumed that kitchen area cost is higher than bedroom area cost)

Finally, the reason why housing projects were modeled instead of building projects is the mortgage system. Mortgage system will come to Turkey in the following months. Mortgage system provides low interest loans for the customers to buy homes. The well known result of the mortgage is that it will increase the demand for residential constructions. In addition to this, housing demand will further increase, because with this system, residents in the city center (building) areas tend to buy new houses at the country site. This demand will increase the number of villa constructions. Due to

this, it was found more beneficial to concentrate on housing constructions rather than building constructions.

Also, increase in the demand will result in new inexperienced contractors in the market. Most important problem of the inexperienced contractors is the lack of adequate budget preparations. This study can guide them during cost estimates.

3.2 RESEARCH METHODOLOGY

Initially, historical cost data about the housing projects were tried to be gathered. However, due to lack of proper cost controlling and accounting in Turkey for residential constructions, it was not possible to collect any such data.

Due to the lack of data, cost calculations were to be made in this study. For this purpose, architectural drawings of five different villa type housing projects were collected and quantity take-offs were performed. During the selection of the projects, it was tried to find various types of projects with a care to avoid any extreme cases. Various types of projects mean, projects having different total area of construction and also having different percentages of functional areas. For example, one project has 20% kitchen area and the other has 10% kitchen area.

Final quantity take-offs were prepared with some assumptions and with the help of recent studies. Ministry of Public Works unit price analysis was used for some work items for example, for concrete and reinforcement pricing. However, pricing of some work items, such as kitchen cabinets, was performed by market search.

During quantity take-offs, some work items were contained in the specific part of the project (kitchen, living room etc.) whereas some items were put for the overall project. For example, cost of kitchen cabinet is naturally included in kitchen cost. Also, window costs were included in the corresponding type of room. Number of

windows for kitchen or bedroom tends to be different, so putting window costs separately to the specific type of rooms, will be beneficial. On the other hand, heating costs per m^2 will be almost equal for different types of rooms and such activity costs will be put to the general cost part.

After the quantity take-offs were completed, market search for each work item was carried out. During market search, only the reliable suppliers were chosen and data were collected as minimum and maximum unit cost of each work item.

After market search, final costs of each project were found as minimum and maximum. For every project, cost of kitchen per m^2, bedrooms per m^2, etc were found and a general cost per m^2 was found. However, this general costs per m^2 was included in each of the kitchen, bedroom, and living room per m2 cost so that the final model will not include unnecessary general cost part.

Per m^2 costs of each project were investigated and an average is taken for these five projects as a model. As a result, final model will include cost per m^2 of kitchen, living room, bedroom, bathroom, entrance & corridors, balconies, storage and terrace.

As a summary thesis study was completed with the following steps;

1. Literature Review
2. Finding the particular area that needs the model most
3. Project search
4. Quantity Take Offs
5. Market Search
6. Cost Calculations
7. Model Preparations
8. Validation

3.3 INFORMATION ABOUT PROJECTS

In the 3rd step, it was tried to find different type of housing projects, so that data of model will be more reliable. 5 projects of total areas ranging from 145 m^2 to 393 m^2 were found. Generally, villa constructions in Ankara are constructed in these ranges. Extreme cases were avoided, since this model is for ordinary housing constructions in Ankara.

Another important point considered during project search is to have projects having different percentages of kitchen area, bathroom area, living area, etc. Final model will include m^2 costs for different rooms and it will be more useful to have projects with different percentages of those areas.

In Ankara, generally villa constructions have 2 floors. So, while founding projects it was tried to find projects having a ground floor and the 1st floor. In two of the projects there are attic stories. However, this attic story was not included in quantity take-off analysis. Also, this will not introduce any error, since if these projects were built for two stories the general architecture would not been changed. On the other hand, if those stories were included these two projects unit area costs would be different than the others.

On the other hand, if there will be a basement floor, project will be 3 stories. In that case, model can be used with following assumptions. Living room areas are generally big areas like the basement areas and it will be consistent to use living room unit area cost for the basement. Model's result will be on the safe side and will not be inconsistent for projects having basement as explained previously. (3 floor house will cost less than 2 floor house in unit area cost basis)

After general information, detailed information about the total and net areas of the projects can be found on the following tables. Net area means, the area not including

walls and other structural units whereas, total or gross area means the total construction area. In the model, total (gross) area is included, since the ministry limits the total area of construction for specific land area. For example, a villa having a total area of 250 m^2 on 1,000 m^2 of land can be constructed.

In following tables, percentages were found by dividing net areas of specific rooms to the total net area of the construction.

Table 3.1 Project 1; Areas (m^2)

PROJECT 1	NET AREA	PERCENTAGE	GROSS AREA
GROUND FLOOR			
KITCHEN	15,94	0,082	18,45
ENTRANCE AND CORRIDORS	19,46	0,100	22,53
STORAGE	3,66	0,019	4,24
BATHROOM 1	2,74	0,014	3,17
WC 1	2,25	0,012	2,60
LIVING ROOM	27,51	0,141	31,85
ROOM 1	25,96	0,133	30,05
1st FLOOR			
BR 1	25,96	0,133	30,05
BR 2	15,96	0,082	18,48
BR 3	12,53	0,064	14,51
BR 4	12,14	0,062	14,05
BATHROOM 2	3,60	0,018	4,17
BATHROOM 3	3,20	0,016	3,70
BATHROOM 4	3,00	0,015	3,47
CORRIDORS	9,71	0,050	11,24
STORAGE	1,23	0,006	1,42
BALCONY	9,81	0,050	11,36
TERRACE	32,38	1,000	32,28
TOTAL AREA	**236,28**		**257,53**

Table 3.2 Project 1; Summation of Areas (m^2)

PROJECT 1	TOTAL AREA
LIVING ROOM	62
KITCHEN	18
BATHROOM	17
BEDROOM	77
ENTRANCE & CORRIDORS	34
STORAGE	6
BALCONY	11
TERRACE	32
TOTAL AREA	**258**
GROUND FLOOR TOTAL AREA	**145**

Table 3.3 Project 2; Areas (m^2)

PROJECT 2	NET AREA	PERCENTAGE	GROSS AREA
GROUND FLOOR			
KITCHEN	15,13	0,050	16,27
ENTRANCE AND CORRIDORS	20,40	0,070	21,93
BATHROOM 1	5,00	0,020	5,38
WC 1	2,66	0,010	2,86
LIVING ROOM	29,87	0,100	32,12
TERRACE	30,60	0,100	32,90
BR 1	10,26	0,030	11,03
BR 2	15,00	0,050	16,13
BR 3	17,10	0,060	18,39
BALCONY 1	2,88	0,010	3,10
BALCONY 2	2,88	0,010	3,10
1st FLOOR			
KITCHEN 2	15,13	0,050	16,27
ENTRANCE AND CORRIDORS 2	20,40	0,070	21,93
BATHROOM 2	5,00	0,020	5,38
WC 2	2,66	0,010	2,86
LIVING ROOM 2	29,87	0,100	32,12
TERRACE 2	30,60	0,100	32,90
BR 4	10,26	0,030	11,03
BR 5	15,00	0,050	16,13
BR 6	17,10	0,060	18,39
BALCONY 3	2,88	0,010	3,10
BALCONY 4	2,88	0,010	3,10
TOTAL AREA	**303,56**	**1,000**	**326,40**

Table 3.4 Project 2; Summation of Areas (m^2)

PROJECT 2	TOTAL AREA
LIVING ROOM	64
KITCHEN	33
BATHROOM	16
BEDROOM	91
ENTRANCE & CORRIDORS	44
BALCONY	12
TERRACE	66
TOTAL AREA	**326**
GROUND FLOOR TOTAL AREA	**163**

Table 3.5 Project 3; Areas (m^2)

PROJECT 3	NET AREA	PERCENTAGE	GROSS AREA
GROUND FLOOR			
KITCHEN	18,08	0,086	20,40
ENTRANCE AND CORRIDORS	13,32	0,064	15,03
BATHROOM 1	6,20	0,030	7,00
WC 1	2,04	0,010	2,30
LIVING ROOM	29,25	0,140	33,01
TERRACE	43,36	0,207	48,13
BR 1	11,55	0,055	13,03
1st FLOOR			
BR 2	14,65	0,070	16,53
ENTRANCE AND CORRIDORS 2	11,97	0,057	13,51
BATHROOM 2	5,04	0,024	5,69
BATHROOM 3	4,34	0,021	4,90
BR 3	14,81	0,071	16,71
BALCONY	5,67	0,027	6,40
BR 4	29,25	0,140	33,01
TOTAL AREA	**209,53**	**1,000**	**236,45**

Table 3.6 Project 3; Summation of Areas (m^2)

PROJECT 3	TOTAL AREA
LIVING ROOM	33
KITCHEN	20
BATHROOM	20
BEDROOM	79
ENTRANCE & CORRIDORS	29
BALCONY	6
TERRACE	48
TOTAL AREA	**236**
GROUND FLOOR TOTAL AREA	**138**

Table 3.7 Project 4; Areas (m^2)

PROJECT 4	NET AREA	PERCENTAGE	GROSS AREA
GROUND FLOOR			
KITCHEN	9,86	0,081	11,70
ENTRANCE AND CORRIDORS	15,98	0,131	18,96
WC 1	4,38	0,036	5,20
LIVING ROOM	14,49	0,119	17,19
STORAGE	3,38	0,028	4,01
BR 1	12,42	0,102	14,73
1st FLOOR			
BR 2	12,27	0,101	14,55
ENTRANCE AND CORRIDORS 2	13,48	0,111	15,99
BATHROOM 1	4,56	0,037	5,41
BATHROOM 2	3,38	0,028	4,01
BR 3	10,79	0,089	12,80
BALCONY	4,66	0,038	5,53
BR 4	12,27	0,101	14,55
TOTAL AREA	**121,92**	**1,000**	**144,62**

Table 3.8 Project 4; Summation of Areas (m^2)

PROJECT 4	TOTAL AREA
LIVING ROOM	17
KITCHEN	12
BATHROOM	15
BEDROOM	57
ENTRANCE & CORRIDORS	35
BALCONY	6
STORAGE	4
TOTAL AREA	**145**
GROUND FLOOR TOTAL AREA	**71**

Table 3.9 Project 5; Areas (m^2)

PROJE 5	NET AREA	PERCENTAGE	GROSS AREA
GROUND FLOOR			
KITCHEN	12,23	0,043	13,83
ENTRANCE AND CORRIDORS	25,70	0,090	29,05
WC	2,94	0,010	3,32
LIVING ROOM	55,78	0,195	63,06
DINING ROOM	19,30	0,067	21,82
ROOM 1	13,86	0,048	15,67
FRONT TERRACE	11,13	0,039	12,58
1st FLOOR			
BR 1	20,20	0,070	22,84
BR 2	27,24	0,095	30,80
BR 3	11,90	0,042	13,45
BR 4	15,30	0,053	17,30
BR 5	13,86	0,048	15,67
BATHROOM 1	11,21	0,039	12,67
BATHROOM 2	1,69	0,006	1,91
BATHROOM 3	1,39	0,005	1,57
CORRIDORS	33,25	0,116	37,59
BALCONY	9,70	0,034	10,97
BACK TERRACE	68,96		68,96
TOTAL AREA	**355,64**	**1,000**	**393,06**

Table 3.10 Project 5; Summation of Areas (m^2)

PROJE 5	TOTAL AREA
LIVING ROOM	85
KITCHEN	14
BATHROOM	19
BEDROOM	116
ENTRANCE & CORRIDORS	67
BALCONY & FRONT TERRACE	24
TERRACE	69
TOTAL AREA	**393**
GROUND FLOOR TOTAL AREA	**228**

CHAPTER 4

QUANTITY TAKE OFF AND COST ASSUMPTIONS

4.1 EXCAVATION AND FILL

It was assumed that a foundation of 75 cm below the ground level would be enough. Since, generally ground floor starts at around 50 cm higher than the ground level, there will be 125 cm of foundation which would be enough for 2 story construction. This 75 cm from ground level will be excavated.

Moreover, it was assumed that all of the construction area will be excavated instead of only foundation wall areas. Main reason behind this is the lack of foundation drawings. This assumption is on the safe side. By this way, there is no need to take possible irregularities in the ground into account. Since this assumption is on the safe side, there is no need to consider side slopes again.

As a result, for excavation, height was taken 75 cm and area was taken as the total construction area of the ground floor.

For the unit cost of excavation, unit price given by Ünal Akçalı [2] was used. For the minimum unit cost 15.0011 was used which is “bina inşaatında makina ile yumuşak ve sert toprakta serbest kazı yapılması” and for the maximum cost 15.0181 was used which is “bina inşaatında makina ile çok sert kayalık zeminde serbest kazı yapılması”. As a result, possible variances in the condition of the soil were taken into account. Also, since there was an assumption of whole area to be excavated in the quantity take off part, it was found more realistic to use “serbest kazı”.

During quantity take off of fill activity, it was assumed that 60% of the excavated

material will be refilled. By this assumption, any fill that can be needed for the construction above the ground level will be included in the take off. This assumption is again on the safe side.

In the cost analysis of the fill activity again unit price in Reference 2 was used and instead of two unit cost assumptions, one cost was assumed which is 14.018 "dolguya gelmiş serilmiş her cins kazının el ile tokmaklanarak tabaka tabaka sıkıştırılması". As can be seen easily, this activity is for every type of soil and it includes variances. Even if the soil condition is hard rock, the rock will not be refilled but a soil will be used for refilling. So this assumption is consistent.

4.2 BLINDING CONCRETE, BLOCKAGE, AND INSULATION

For all of these activities, it was assumed that area would be the net area of the ground floor, so that area of the foundation walls will not be included in the area of these activities.

10 cm of thickness was assumed for the blinding concrete. For the blockage, 15 cm thickness was assumed. These are the general used thicknesses for the residential constructions. Insulation at the ground level was calculated as an area.

Again for these activities unit price in Ref. 2 was used. 16.001 and 16.057 was used for blinding concrete. These are "150 dozlu demirsiz beton" and "satın alınan ve beton pompasıyla basılan hazır beton BS.14 betonu" respectively and correspond for minimum and maximum costs. Minimum unit cost was chosen since it was the minimum cost for concrete. Also, for the maximum BS 14 was found suitable. In other words more than BS 14 would be unnecessary for blinding concrete.

For the blockage activity minimum unit cost was 17.137 which is "kazı taşı ile

blokaj" and the maximum unit cost is 17.138 which is "toplama taşı ile blokaj". Generally, these types are used.

For water proof insulation, market search was performed to find the minimum and maximum unit costs.

4.3 CONCRETE AND REINFORCEMENT

In 2005 Unit Price Analysis of Construction Works book by Ünal Akçalı there is a part for conceptual estimating which gives several amounts of construction works for 1 m^2 of construction of residential buildings. It is very useful, since this research was done considering lots of projects and results give accurate results. Even it is known that some contractors use these percentages for the bidding of TOKİ projects.

In Ünal Akçalı's research, it was found that 0.380 m^3 of concrete and 34 kg of reinforcement are required in 1 m^2 of residential construction [2]. In addition to the accuracy of these values, there is another reason to use this research. There were only architectural drawings for the projects and there was no information about civil and structural drawings. As a result, concrete and reinforcement amounts were found by considering the total construction area of the projects. Another point in here is that the terrace area is also included in the total area. This assumption is on the safe side, and covers some possible low estimates due to the usage of approximate amounts for concrete and reinforcement. It is obvious that less concrete and reinforcement will be used for terraces. (Even in some cases, only blinding concrete is used for terraces) So, by including terrace areas into total area and calculating reinforcement and concrete amounts by this total area, a contingency was provided for these work items.

For concrete pricing, minimum unit price was taken as 16.0571 which is "satın alınan ve beton pompasıyla basılan BS 16 betonu" and maximum unit price was 16.0581 which is "satın alınan ve beton pompasıyla basılan BS 20 betonu". BS 16, BS 18 or

BS 20 concretes are used for housing constructions in Turkey.

In reinforcement pricing, following unit prices were used for minimum and maximum respectively; 23.0011 “çapı (8-12) mm lik çelik çubukların projesine göre bükülmesi ve yerine konulması” and 23.002 “çapı (14-50) mm lik çelik çubukların projesine göre bükülmesi ve yerine konulması”. There is no information about the sizes of the reinforcement bars in architectural drawings of the projects, but the minimum possible bar size that can be used in constructions is 8 mm, and maximum that generally used is bigger than 14 mm. As a result, minimum and maximum costs were assumed as stated.

4.4 FORMWORK AND SCAFFOLDING

Again for formwork amount, there is an approximate percentage for 1 m^2 of construction in Ünal Akçalı’s research[2]. It was found in that research that 2,6 m^2 of formwork is used for 1 m^2 of construction. This is the total amount of formwork without considering possible reusage of formwork. This percentage was used in this study. However, in this thesis, since constructions have two floors, it was assumed that the formwork amount that will be found by Ünal Akçalı’s research will be used twice.

It is known that formwork unit prices for slab formworks and other formworks are different. Since this is the case, it was found suitable to find the formwork amount that will be used for slab. While finding the area, the maximum total area of the 2 floors were chosen as the required slab area. Since in the price analysis, voids are not taken into account, gross area for the floor having biggest total area was used.

After finding total required formwork amount by Ünal Akçalı’s research and the required slab formwork amount, amount of other types of formworks was found by subtracting slab formwork amount from total required formwork. Pricing was done

separately for slab formworks and other types of formworks.

For the price analysis of slab formwork, unit price code number 21.037 was used for minimum cost which is “bloklu betonarme döşeme için kalıp (ızgaralı)” and for maximum unit price 21.038 was used which is “bloklu betonarme için kalıp (aralıksız)”. These unit prices were used since these are the real applications.

For the other formworks minimum unit price, code number 21.011 was used, which is “düz yüzeyli beton ve betonarme kalıbı”. 21.0171, which is “plywood ile yapılan düz yüzeyli çıplak beton veya betonarme kalıbı” was used for the maximum unit price.

Scaffolding was divided into two as slab formwork scaffolding and scaffolding for plastering and painting of walls. For the first one, necessary volume was found by multiplying total slab area with the maximum height of the two floors. Scaffolding will be used for both floors. For the pricing 21.054 was used which is “en yüksek noktası 4.00 m ye kadar olan yapı sinai imalata ait ahşap kalıp iskelesi”. This activity has no minimum or maximum cost. Floor heights of villas can not be higher than 4 meters.

Quantity take off for the work item; scaffolding for walls, was performed by considering the total height of the building from ground level to the fringe elevation, (in other words the elevation of the start of the roof). Ground floors total perimeter was used to calculate the total area needed for the scaffolding. 21.065 was used for the pricing which is “iş iskelesi (0-12,5 m yükseklik için)”. Again in this activity there are no possible price alternatives. Of course, these prices can change with the material that will be used for the scaffolding, but this unit price represents the general construction attitude and it is thought that, there is no need for market search for this work item.

4.5 OUTER AND INNER WALLS

It was assumed that light cement blocks were used for the walls since this is the trend in residential constructions. Outer walls are 25 cm thick and inner walls are 10 cm thick. Sandwich system was used for the insulation of the outer walls. Between two 10 cm cement block a 5 cm rock wool is placed. Again this is an assumption, but this decision was again taken by considering the real construction examples. Cheap and unreliable insulation and bricking techniques were disregarded since the constructions, which model will be used, will be villa constructions having quality.

Another assumption is that below the ground floor all the walls are reinforced concrete. In other words, the foundation will be totally reinforced concrete. Again this is the case in real constructions.

10 cm thick cement blocks code number is 18.112 “10 cm kalınlığındaki hafif gazbeton bloklarla özel tutkallı duvar yapılması”.

For the rock wool, 19.0495 was used which is “çatılarda cam yünü ile ısı yalıtımı yapılması ve üzerine bir kat bitümlü karton serilmesi (5 cm kalınlığındaki taş yünü ile”. It can be seen that this code number is not for sandwich system. In this book, for wall insulation it gives pricing for insulation from outer part of the wall, (“mantolama”). It does not give pricing for the sandwich system type of rock wool insulation. This outer insulation is completely different and more expensive than what will be done for our assumption. However, sandwich case is very similar to the code 19.0495. Only the rock wool will be used in between the cement blocks and the workmanship is similar to those for roof insulation. Also, when the code was analyzed, it was seen that most of the unit price is consist of the material cost. This material cost is equal for the sandwich system and the roofing insulation. As a result, it is found suitable to use this code for price analysis of the wall insulations.

In inner and outer walls and also for the rock wool minimum and maximum costs were not used since these prices are constant. Only one type of wall structure was assumed. Bricks can be used but as explained earlier, cement blocks are the new trend in construction and also, the final model will be used for villa constructions, which will have good quality.

4.6 PLASTERING AND WHITE WASH FOR CEILINGS

Total area of these activities was found by summing total net area of the two floors. This area is not equal to the area used in slab formwork analysis. In other words, by this way, wall areas in plan are subtracted for these items.

Code number 27.535 was used for the plastering which is “kireç çimento karışımı harçla tavan sıvası (1,2 cm)”. For the white wash 25.046 “yeni sıva yüzeylerine renkli üç kat kireç badana yapılması” was used. These are the real utilization for the residential constructions. Again, it was assumed that there is no price variance in these activities.

4.7 EXTERIOR WALL PLASTERING, PAINT AND COVERING

Quantity take-off for these activities was different than the take-off for the exterior wall area. First reason is that, there are some concreting areas to be plastered in addition to wall area. Second one is that while calculating plastering for the ground floor instead of floor height, elevation from the ground level was used. Perimeter of the floors and corresponding heights were calculated and window and door voids were subtracted.

27.503 “düz sıva yapılması (dış sıva)” was used for plastering. This is 2 cm thick plastering which used in residential constructions. Again only one price was assumed for this activity.

Instead of using unit price analysis [2] it was found more useful to found costs of the external paint and coverings from the market search. For the maximum unit price siding price was used and for the minimum unit price ordinary exterior paint price was used. Siding costs more, but it is widely used in newly constructed house projects so it was included in this thesis.

4.8 ROOF COVERING, FRAMING AND INSULATION

Quantity take-offs were performed considering roof projection area (horizontal) for these activities.

Market search was performed to find the cost for covering. For the maximum cost, shingle was used whereas for the minimum cost ordinary roof tile was considered. While finding unit price from the suppliers, a total price including costs of any necessary water insulation below the tiles and also the wood under the tiles, were wanted. In other words, cost of any necessary part for the roof, in addition to the roof framing was wanted. Also, all of the market costs include manpower and transportation costs.

Roof framing unit price was found using code number 21.210 “çam kerestesi ile ahşap oturtma çatı yapılması” and code 21.245 “kullanılmış çam kerestesi ile ahşap oturtma çatı yapılması” for maximum and minimum unit prices respectively.

For the heat insulation again rock wool was used, and minimum and maximum unit prices were found considering the possible thicknesses of the rock wool. For the minimum cost code number 19.0481 “çatılarda cam yünü ile ısı yalıtımı yapılması ve üzerine bir kat bitümlü karton serilmesi (2 cm kalınlığında cam yünü ile 50 kg/m^3)” was used and for the maximum 19.0495 “çatılarda cam yünü ile ısı yalıtımı yapılması ve üzerine bir kat bitümlü karton serilmesi (5 cm kalınlığında cam yünü ile

110 kg/m^3)" was used. The choice depends on the quality of the construction.

4.9 MECHANICAL, ELECTRICAL, HEATING

In 2005 Unit Price Analysis of Construction Works book by Ünal Akçalı there is a part for conceptual estimating which gives several percentages for the prices of mechanical, electrical and heating to the total cost of the structure. There is no information about the electrical and mechanical drawings so this approach will be used in this study. Electrical costs 5%, mechanical 4% and heating 6% of the total construction cost. Total prices will be increased considering these percentages.

4.10 DOORS

Numbers of necessary doors (quantities) were found considering different sizes of doors. Entrance door was included as a general cost whereas inner doors were included for each type of rooms. (Kitchen, bathroom etc.) During quantity take-off, number of doors for specific rooms was counted. However, by doing these inner doors were counted twice. (Door opens to two rooms). In other words, for example, one door was also included for living room and entrance and corridors. Due to this, final quantities for each room were half of those found for each room in the quantity take-offs.

After finding necessary quantities, prices were found by market search. Sizes of doors were sent to the suppliers and offers were taken and minimum and maximum prices for each size of doors were determined. Inner doors and doors opening to the outdoor, except the entrance door; considered to be the same since costs of such doors tend to be close.

4.11 WINDOWS

Windows in each type of rooms were determined for different sizes of windows. After, finding the necessary sizes of windows results were sent to the suppliers and offer prices were taken.

4.12 INTERNAL PLASTER AND PAINT

Interior plastering and paint prices were included in specific cost parts. (Living room, kitchen and etc.) Quantities were calculated using perimeter and height of the rooms and subtracting any voids of doors and windows.

Code number 27.531 which is "kireç çimento karışımı harçla düz sıva yapılması" was used for the interior plastering. This plastering has a thickness of 0,8 cm, which is generally the thickness of plastering for house constructions.

In kitchen, living rooms, entrance and corridors, bedrooms and storage rooms, normal internal paint was assumed to be used. For bathrooms wall tiles were used. Prices were found from market search as minimum and maximum.

4.13 FLOOR COVERINGS

Floor areas were calculated using AutoCAD program's area command. Wall areas were not included. Net areas were calculated. Areas were found for every room in the project. Areas of the specific types of rooms were added to find the required floor coverings for various types of rooms. (Kitchen, bathroom and etc.) For example, net areas for bedroom 1 and 2 was calculated and then added to find the total area for bedroom floor covering.

For the living room lamina and laminate parquet were used. In kitchen and entrance and corridors, marbles, ceramics or granites were used. Ceramics were used for

bathrooms, storage rooms, balconies and terraces. Laminate parquet or carpets were used in bedrooms. Prices were obtained from several suppliers and minimum and maximum unit prices were obtained for each type of rooms.

4.14 KITCHEN CABINETS

Architectural drawings of every project were sent to the reliable suppliers and offers were taken for the kitchen cabinets and kitchen counters. Maximum and minimum prices were obtained by analyzing the offers.

4.15 BATHROOM FAUCETS, WASHBASINS, BATH TUBS, CLOSETS

Each of the bathrooms was analyzed and total cost for each project for the bathroom accessories were found as minimum and maximum. For the pricing several suppliers were chosen. In the price analysis extreme cases were avoided.

All of the market prices include transportation and labor price. Moreover, only the reliable, well known suppliers were chosen.

Details of the bathroom pricings can be found on the appendix F. When the areas of the bathrooms increased, the unit area cost of the bathrooms decrease. The reason behind is that all of the bathrooms has one washbasin, one toilet closet and also one door and etc. So, when the area of the bathroom is increased unit area cost is reduced.

CHAPTER 5

COST CALCULATIONS AND RESULTS

5.1 INTRODUCTION AND COST CALCULATIONS

Detailed information about the quantity take off can be found in appendices. Appendices A, B, C, D, and E have quantity take-off details of projects 1, 2, 3, 4, and 5 respectively. Assumptions mentioned in the preceding chapter was used during the quantity take-off and cost calculation processes.

After performing the quantity take-offs and market searches, tables which are given in the following pages were established for each project. All prices in the tables are YTL. 5% additional cost was assumed for the items that are not included in cost calculations like metal balustrades, staircases, general expenses and also for some contingency. There was no information about balustrades in the drawings.

Number of staircases was not included in the quantity take-off. However, the horizontal projection of staircase area was included in the entrance and corridors floor covering area. By this way, staircase cost was included in entrance and corridors part. However, there are balustrades, and also, cost of staircases is more than cost of floor covering. As stated above, 5% was found enough for some missing (small) items like these and also for the contingency.

There is a general cost part in cost calculation tables and also, there are some specific calculations for different types of rooms. As stated earlier, some cost items like, heating costs was considered in the general cost part since those items tend to cost same for different type of rooms (YTL/m^2 basis). However, cost of some items like floor coverings, change for different types of rooms. For example, for bathrooms,

ceramics were used, whereas for living rooms, parquets were used, and these materials cost different.

Minimum and maximum total cost was calculated for the general cost part and this value was divided with total area of the construction and, a unit area price for the general part was obtained.

Also, minimum and maximum total cost was calculated for the specific cost parts and this value was divided with the corresponding area of the type of the room.

As a result, there was a general unit area cost and unit area costs for specific room types. A model could have been developed considering general and specific unit area costs. However, it would be better to delete this general cost part from the model. It is known that, unit area cost for the general cost part is same for each type of rooms. This unit area cost for the general part can be included in each of the specific part costs. For this purpose, unit area costs for specific type of rooms was added with the unit area costs for the general part and a final specific unit area costs were obtained.

For example, in project 1 minimum unit area cost for the general part was found as 227 YTL/m^2 and minimum specific unit area cost for kitchen was found as 273 YTL/m^2. Final kitchen area unit cost was obtained by adding these two values (500 YTL/m^2). Final unit prices for each type of the rooms were obtained in the same way.

Table 5.1 Project 1 Cost Calculations

GENERAL PART: Total Construction Area = 258 m2			***UNIT COST (YTL/unit)***		***TOTAL COST (YTL)***	
WORK ITEMS	***UNIT***	***AMOUNT***	***MINIMUM***	***MAXIMUM***	***MINIMUM***	***MAXIMUM***
EXCAVATION	m3	109,0	1,27	7,62	138,43	830,58
FILL	m3	65,0	2,39	2,39	155,35	155,35
BLINDING CONCRETE	m3	13,0	50,03	57,32	650,39	745,16
BLOCKAGE	m3	19,4	21,10	26,16	409,34	507,50
WATERPROOF INSULATION	m2	130,0	10,50	13,70	1.365,00	1.781,00
CONCRETE	m3	98,0	58,82	62,32	5.764,36	6.107,36
REINFORCEMENT	tons	8,8	865,15	940,85	7.613,32	8.279,48
FORMWORK-SLAB	m2	113,0	4,50	5,85	508,50	661,05
FORMWORK-OTHERS	m2	222,0	8,73	11,89	1.938,06	2.639,58
FORMWORK SCAFFOLDING	m3	302,0	1,51	1,51	456,02	456,02
SCAFFOLDING FOR PAINT	m2	300,0	1,86	1,86	558,00	558,00
25 cm HOLLOW CEMENT BLOCK	m2	160,0	27,06	27,06	4.329,60	4.329,60
10 cm HOLLOW CEMENT BLOCK	m2	122,0	13,53	13,53	1.650,66	1.650,66
PLASTERING - SLABS -	m2	195,0	4,85	4,85	945,75	945,75
WHITE WASH - SLABS -	m2	195,0	0,77	0,77	150,15	150,15
EXTERIOR PLASTERING	m2	246,0	6,65	6,65	1.635,90	1.635,90
EXTERNAL COVERINGS OR PAINT	m2	246,0	6,00	30,00	1.476,00	7.380,00
WALL INSULATION	m2	246,0	20,27	20,27	4.986,42	4.986,42
ROOF FRAMING	m2	139,0	12,38	26,64	1.720,82	3.702,96
ROOF COVERING	m2	139,0	25,00	40,00	3.475,00	5.560,00
ROOF HEAT INSULATION	m2	139,0	7,73	20,27	1.074,47	2.817,53
ENTRTANCE DOOR(80/210)	pieces	2,0	450,00	1.200,00	900,00	2.400,00
ELECTRICITY	pieces	1,0	4.163,28	6.045,62	4.163,28	6.045,62
MECHANICAL	pieces	1,0	3.330,62	4.836,49	3.330,62	4.836,49
HEATING	pieces	1,0	4.995,94	7.254,74	4.995,94	7.254,74
GENERAL EXPENSES	pieces	1,0	4.163,28	6.045,62	4.163,28	6.045,62

Table 5.1 (continued) Project 1 Cost Calculations

LIVING ROOM SPECIFIC COST ITEMS, Area = 62 m2						
PAINT	m2	86,0	2,75	3,25	236,50	279,50
INTERNAL PLASTER	m2	86,0	5,06	5,06	435,16	435,16
WINDOWS (235/150)	pieces	1,0	425,00	655,00	425,00	655,00
WINDOWS (200/150)	pieces	1,0	261,00	356,00	261,00	356,00
WINDOWS (80/150)	pieces	4,0	153,00	221,00	612,00	884,00
DOORS (90/210)	pieces	2,5	225,00	450,00	562,50	1.125,00
FLOOR COVERING	m2	53,5	13,00	42,00	695,50	2.247,00
KITCHEN SPECIFIC COST ITEMS, Area = 18 m2						
PAINT	m2	37,0	2,75	3,25	101,75	120,25
INTERNAL PLASTER	m2	37,0	5,06	5,06	187,22	187,22
WINDOWS (150/150)	pieces	1,0	221,00	310,00	221,00	310,00
DOORS (90/210)	pieces	1,0	225,00	450,00	225,00	450,00
FLOOR COVERING	m2	16,0	24,00	38,00	384,00	608,00
KITCHEN CABINETS	pieces	1,0	3.800,00	4.250,00	3.800,00	4.250,00
BATHROOM SPECIFIC COST ITEMS, Area = 17 m2						
CERAMIC WALL COVERINGS	m2	91,0	16,00	30,00	1.456,00	2.730,00
INTERNAL PLASTER	m2	91,0	5,06	5,06	460,46	460,46
WINDOWS (50/70)	pieces	4,0	90,00	106,00	360,00	424,00
WINDOWS (80/160)	pieces	1,0	146,00	229,00	146,00	229,00
DOORS (90/210)	pieces	2,5	225,00	450,00	562,50	1.125,00
FLOOR COVERING	m2	15,0	16,00	30,00	240,00	450,00
BATHROOM ACC	pieces	1,0	3.380,00	4.920,00	3.380,00	4.920,00

Table 5.1 (continued) Project 1 Cost Calculations

BEDROOM SPECIFIC COST ITEMS, Area = 77 m2						
PAINT	m2	143,0	2,75	3,25	393,25	464,75
INTERNAL PLASTER	m2	143,0	5,06	5,06	723,58	723,58
WINDOWS (80/150)	pieces	4,0	153,00	221,00	612,00	884,00
WINDOWS (235/150)	pieces	1,0	425,00	655,00	425,00	655,00
WINDOWS (200/150)	pieces	1,0	261,00	356,00	261,00	356,00
WINDOWS (150/150)	pieces	2,0	221,00	310,00	442,00	620,00
DOORS (90/210)	pieces	4,5	225,00	450,00	1.012,50	2.025,00
FLOOR COVERING	m2	67,0	7,50	20,00	502,50	1.340,00
ENTRANCE & CORRIDORS SPECIFIC COST ITEMS, Area = 34 m2						
PAINT	m2	76,0	2,75	3,25	209,00	247,00
INTERNAL PLASTER	m2	76,0	5,06	5,06	384,56	384,56
WINDOWS (150/150)	pieces	1,0	221,00	310,00	221,00	310,00
DOORS (90/210)	pieces	6,0	225,00	450,00	1.350,00	2.700,00
FLOOR COVERING	m2	29,0	13,00	22,00	377,00	638,00
STORAGE ROOM SPECIFIC COST ITEMS, Area = 6 m2						
PAINT	m2	31,0	2,75	3,25	85,25	100,75
INTERNAL PLASTER	m2	31,0	5,06	5,06	156,86	156,86
WINDOWS (50/70)	pieces	1,0	90,00	106,00	90,00	106,00
DOORS (90/210)	pieces	1,0	225,00	450,00	225,00	450,00
FLOOR COVERING	m2	4,9	7,50	13,00	36,75	63,70

Table 5.1 (continued) Project 1 Cost Calculations

BALCONY SPECIFIC COST ITEMS, Area = 11 m2						
DOORS (90/210)	pieces	1,0	225,00	450,00	225,00	450,00
FLOOR COVERING	m2	9,8	12,00	20,00	117,60	196,00
TERRACE SPECIFIC COST ITEMS, Area = 32 m2						
FLOOR COVERING	m2	32,0	16,00	24,00	512,00	768,00
ROOF TERRACE	m2	42,0	30,00	45,00	1.260,00	1.890,00
DOORS (90/210)	pieces	1,5	225,00	450,00	337,50	675,00
TERRACE	m2	32,0				
				TOTAL COST	***83.265,60***	***120.912,31***
				OVERALL UNIT COST	***322,73***	***468,65***

Table 5.2 Project 2 Cost Calculations

GENERAL PART: Total Construction Area = 326 m2			***UNIT COST (YTL/unit)***		***TOTAL COST (YTL)***	
WORK ITEMS	***UNIT***	***AMOUNT***	***MINIMUM***	***MAXIMUM***	***MINIMUM***	***MAXIMUM***
EXCAVATION	m3	122,0	1,27	7,62	154,94	929,64
FILL	m3	73,0	2,39	2,39	174,47	174,47
BLINDING CONCRETE	m3	15,2	50,03	57,32	760,46	871,26
BLOCKAGE	m3	22,8	21,10	26,16	481,08	596,45
WATERPROOF INSULATION	m2	152,0	10,50	13,70	1.596,00	2.082,40
CONCRETE	m3	115,0	58,82	62,32	6.764,30	7.166,80
REINFORCEMENT	tons	10,3	865,15	940,85	8.911,05	9.690,76
FORMWORK-SLAB	m2	163,0	4,50	5,85	733,50	953,55
FORMWORK-OTHERS	m2	232,0	8,73	11,89	2.025,36	2.758,48
FORMWORK SCAFFOLDING	m3	437,0	1,51	1,51	659,87	659,87
SCAFFOLDING FOR PAINT	m2	320,0	1,86	1,86	595,20	595,20
25 cm HOLLOW CEMENT BLOCK	m2	201,0	27,06	27,06	5.439,06	5.439,06
10 cm HOLLOW CEMENT BLOCK	m2	146,0	13,53	13,53	1.975,38	1.975,38
PLASTERING - SLABS -	m2	304,0	4,85	4,85	1.474,40	1.474,40
WHITE WASH - SLABS -	m2	304,0	0,77	0,77	234,08	234,08
EXTERIOR PLASTERING	m2	263,0	6,65	6,65	1.748,95	1.748,95
EXTERNAL COVERINGS OR PAINT	m2	263,0	6,00	30,00	1.578,00	7.890,00
WALL INSULATION	m2	201,0	20,27	20,27	4.074,27	4.074,27
ROOF FRAMING	m2	171,0	12,38	26,64	2.116,98	4.555,44
ROOF COVERING	m2	171,0	25,00	40,00	4.275,00	6.840,00
ROOF HEAT INSULATION	m2	171,0	7,73	20,27	1.321,83	3.466,17
ENTRTANCE DOOR(100/220)	pieces	1,0	500,00	1.450,00	500,00	1.450,00
ELECTRICITY	pieces	1,0	4.909,21	7.038,03	4.909,21	7.038,03
MECHANICAL	pieces	1,0	3.927,37	5.630,42	3.927,37	5.630,42
HEATING	pieces	1,0	5.891,06	8.445,64	5.891,06	8.445,64
GENERAL EXPENSES	pieces	1,0	4.909,21	7.038,03	4.909,21	7.038,03

Table 5.2 (continued) Project 2 Cost Calculations

LIVING ROOM SPECIFIC COST ITEMS, Area = 64 m2						
PAINT	m2	105,0	2,75	3,25	288,75	341,25
INTERNAL PLASTER	m2	105,0	5,06	5,06	531,30	531,30
WINDOWS (240/160)	pieces	2,0	380,00	530,00	760,00	1.060,00
DOORS (90/220)	pieces	1,0	240,00	480,00	240,00	480,00
DOORS (80/220)	pieces	2,0	225,00	450,00	450,00	900,00
FLOOR COVERING	m2	60,0	13,00	42,00	780,00	2.520,00
KITCHEN SPECIFIC COST ITEMS, Area = 33 m2						
PAINT	m2	72,0	2,75	3,25	198,00	234,00
INTERNAL PLASTER	m2	72,0	5,06	5,06	364,32	364,32
WINDOWS (100/130)	pieces	4,0	150,00	240,00	600,00	960,00
DOORS (90/220)	pieces	2,0	240,00	480,00	480,00	960,00
FLOOR COVERING	m2	30,0	24,00	38,00	720,00	1.140,00
KITCHEN CABINETS	pieces	1,0	7.860,00	8.450,00	7.860,00	8.450,00
BATHROOM SPECIFIC COST ITEMS, Area = 16 m2						
CERAMIC WALL COVERINGS	m2	83,0	16,00	30,00	1.328,00	2.490,00
INTERNAL PLASTER	m2	83,0	5,06	5,06	419,98	419,98
WINDOWS (60/60)	pieces	4,0	90,00	106,00	360,00	424,00
DOORS (90/220)	pieces	2,0	240,00	480,00	480,00	960,00
FLOOR COVERING	m2	15,0	16,00	30,00	240,00	450,00
BATHROOM ACC	pieces	1,0	2.166,00	3.220,00	2.166,00	3.220,00

Table 5.2 (continued) Project 2 Cost Calculations

BEDROOM SPECIFIC COST ITEMS, Area = 91 m2						
PAINT	m2	210,0	2,75	3,25	577,50	682,50
INTERNAL PLASTER	m2	210,0	5,06	5,06	1.062,60	1.062,60
WINDOWS (100/130)	pieces	4,0	150,00	240,00	600,00	960,00
WINDOWS (130/130)	pieces	6,0	185,00	262,00	1.110,00	1.572,00
DOORS (90/220)	pieces	5,0	240,00	480,00	1.200,00	2.400,00
FLOOR COVERING	m2	85,0	7,50	20,00	637,50	1.700,00
ENTRANCE & CORRIDORS SPECIFIC COST ITEMS, Area = 44 m2						
PAINT	m2	110,0	2,75	3,25	302,50	357,50
INTERNAL PLASTER	m2	110,0	5,06	5,06	556,60	556,60
WINDOWS (100/130)	pieces	1,0	150,00	240,00	150,00	240,00
DOORS (80/220)	pieces	2,0	225,00	450,00	450,00	900,00
DOORS (90/220)	pieces	6,0	240,00	480,00	1.440,00	2.880,00
DOORS (100/220)	pieces	2,0	260,00	520,00	520,00	1.040,00
FLOOR COVERING	m2	41,0	13,00	22,00	533,00	902,00
BALCONY SPECIFIC COST ITEMS, Area = 12 m2						
DOORS (90/220)	pieces	2,0	240,00	480,00	480,00	960,00
FLOOR COVERING	m2	11,5	12,00	20,00	138,00	230,00
TERRACE SPECIFIC COST ITEMS, Area = 66 m2						
FLOOR COVERING	m2	61,2	16,00	24,00	979,20	1.468,80
ROOF TERRACE	m2	49,0	30,00	45,00	1.470,00	2.205,00
DOORS (90/220)	pieces	2,0	240,00	480,00	480,00	960,00
				TOTAL COST	***98.184,28***	***140.760,60***
				GENERAL UNIT COST	***301,18***	***431,78***

Table 5.3 Project 3 Cost Calculations

GENERAL PART: Total Construction Area = 236 m2			***UNIT COST (YTL/unit)***		***TOTAL COST (YTL)***	
WORK ITEMS	***UNIT***	***AMOUNT***	***MINIMUM***	***MAXIMUM***	***MINIMUM***	***MAXIMUM***
EXCAVATION	m3	103,0	1,27	7,62	130,81	784,86
FILL	m3	62,0	2,39	2,39	148,18	148,18
BLINDING CONCRETE	m3	12,4	50,03	57,32	620,37	710,77
BLOCKAGE	m3	18,6	21,10	26,16	392,46	486,58
WATERPROOF INSULATION	m2	124,0	10,50	13,70	1.302,00	1.698,80
CONCRETE	m3	90,0	58,82	62,32	5.293,80	5.608,80
REINFORCEMENT	tons	8,0	865,15	940,85	6.921,20	7.526,80
FORMWORK-SLAB	m2	137,0	4,50	5,85	616,50	801,45
FORMWORK-OTHERS	m2	170,0	8,73	11,89	1.484,10	2.021,30
FORMWORK SCAFFOLDING	m3	380,0	1,51	1,51	573,80	573,80
SCAFFOLDING FOR PAINT	m2	316,0	1,86	1,86	587,76	587,76
25 cm HOLLOW CEMENT BLOCK	m2	151,0	27,06	27,06	4.086,06	4.086,06
10 cm HOLLOW CEMENT BLOCK	m2	89,0	13,53	13,53	1.204,17	1.204,17
PLASTERING - SLABS -	m2	166,0	4,85	4,85	805,10	805,10
WHITE WASH - SLABS -	m2	166,0	0,77	0,77	127,82	127,82
EXTERIOR PLASTERING	m2	263,0	6,65	6,65	1.748,95	1.748,95
EXTERNAL COVERINGS OR PAINT	m2	263,0	6,00	30,00	1.578,00	7.890,00
WALL INSULATION	m2	151,0	20,27	20,27	3.060,77	3.060,77
ROOF FRAMING	m2	131,0	12,38	26,64	1.621,78	3.489,84
ROOF COVERING	m2	131,0	25,00	40,00	3.275,00	5.240,00
ROOF HEAT INSULATION	m2	131,0	7,73	20,27	1.012,63	2.655,37
ENTRTANCE DOOR(100/210)	pieces	1,0	480,00	1.350,00	480,00	1.350,00
ELECTRICITY	pieces	1,0	3.636,79	5.311,41	3.636,79	5.311,41
MECHANICAL	pieces	1,0	2.909,43	4.249,13	2.909,43	4.249,13
HEATING	pieces	1,0	4.364,15	6.373,69	4.364,15	6.373,69
GENERAL EXPENSES	pieces	1,0	3.636,79	5.311,41	3.636,79	5.311,41

Table 5.3 (continued) Project 3 Cost Calculations

LIVING ROOM SPECIFIC COST ITEMS, Area = 33 m2						
PAINT	m2	51,0	2,75	3,25	140,25	165,75
INTERNAL PLASTER	m2	51,0	5,06	5,06	258,06	258,06
WINDOWS (70/160)	pieces	7,0	132,00	214,00	924,00	1.498,00
DOORS (115/210)	pieces	0,5	260,00	520,00	130,00	260,00
FLOOR COVERING	m2	29,0	13,00	42,00	377,00	1.218,00
KITCHEN SPECIFIC COST ITEMS, Area = 20 m2						
PAINT	m2	42,0	2,75	3,25	115,50	136,50
INTERNAL PLASTER	m2	42,0	5,06	5,06	212,52	212,52
WINDOWS (220/150) CURVED	pieces	1,0	580,00	712,00	580,00	712,00
WINDOWS (70/160)	pieces	2,0	132,00	214,00	264,00	428,00
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	18,0	24,00	38,00	432,00	684,00
KITCHEN CABINETS	pieces	1,0	2.870,00	3.350,00	2.870,00	3.350,00
BATHROOM SPECIFIC COST ITEMS, Area = 20 m2						
CERAMIC WALL COVERINGS	m2	84,0	16,00	30,00	1.344,00	2.520,00
INTERNAL PLASTER	m2	84,0	5,06	5,06	425,04	425,04
WINDOWS (60/60)	pieces	4,0	90,00	106,00	360,00	424,00
DOORS (90/210)	pieces	2,0	225,00	450,00	450,00	900,00
FLOOR COVERING	m2	17,6	16,00	30,00	281,60	528,00
BATHROOM ACC	pieces	1,0	2.793,00	3.950,00	2.793,00	3.950,00

Table 5.3 (continued) Project 3 Cost Calculations

BEDROOM SPECIFIC COST ITEMS, Area = 79 m2						
PAINT	m2	160,0	2,75	3,25	440,00	520,00
INTERNAL PLASTER	m2	160,0	5,06	5,06	809,60	809,60
WINDOWS (70/160)	pieces	13,0	132,00	214,00	1.716,00	2.782,00
WINDOWS (220/150) CURVED	pieces	1,0	580,00	712,00	580,00	712,00
DOORS (90/210)	pieces	2,5	225,00	450,00	562,50	1.125,00
FLOOR COVERING	m2	70,0	7,50	20,00	525,00	1.400,00
ENTRANCE & CORRIDORS SPECIFIC COST ITEMS, Area = 29 m2						
PAINT	m2	61,0	2,75	3,25	167,75	198,25
INTERNAL PLASTER	m2	61,0	5,06	5,06	308,66	308,66
WINDOWS (70/160)	pieces	1,0	132,00	214,00	132,00	214,00
DOORS (115/210)	pieces	0,5	260,00	520,00	130,00	260,00
DOORS (90/210)	pieces	4,5	225,00	450,00	1.012,50	2.025,00
FLOOR COVERING	m2	25,0	13,00	22,00	325,00	550,00
BALCONY SPECIFIC COST ITEMS, Area = 6 m2						
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	5,7	12,00	20,00	68,40	114,00
TERRACE SPECIFIC COST ITEMS, Area = 48 m2						
FLOOR COVERING	m2	43,0	16,00	24,00	688,00	1.032,00
ROOF TERRACE	m2	49,0	30,00	45,00	1.470,00	2.205,00
				TOTAL COST	***72.735,80***	***106.228,19***
				OVERALL UNIT COST	***308,20***	***450,12***

Table 5.4 Project 4 Cost Calculations

GENERAL PART: Total Construction Area = 145 m2			***UNIT COST (YTL/unit)***		***TOTAL COST (YTL)***	
WORK ITEMS	***UNIT***	***AMOUNT***	***MINIMUM***	***MAXIMUM***	***MINIMUM***	***MAXIMUM***
EXCAVATION	m3	53,0	1,27	7,62	67,31	403,86
FILL	m3	32,0	2,39	2,39	76,48	76,48
BLINDING CONCRETE	m3	6,1	50,03	57,32	305,18	349,65
BLOCKAGE	m3	9,1	21,10	26,16	192,01	238,06
WATERPROOF INSULATION	m2	60,0	10,50	13,70	630,00	822,00
CONCRETE	m3	55,0	58,82	62,32	3.235,10	3.427,60
REINFORCEMENT	tons	4,9	865,15	940,85	4.239,24	4.610,17
FORMWORK-SLAB	m2	74,0	4,50	5,85	333,00	432,90
FORMWORK-OTHERS	m2	114,0	8,73	11,89	995,22	1.355,46
FORMWORK SCAFFOLDING	m3	198,0	1,51	1,51	298,98	298,98
SCAFFOLDING FOR PAINT	m2	218,0	1,86	1,86	405,48	405,48
25 cm HOLLOW CEMENT BLOCK	m2	137,0	27,06	27,06	3.707,22	3.707,22
10 cm HOLLOW CEMENT BLOCK	m2	85,0	13,53	13,53	1.150,05	1.150,05
PLASTERING - SLABS -	m2	122,0	4,85	4,85	591,70	591,70
WHITE WASH - SLABS -	m2	122,0	0,77	0,77	93,94	93,94
EXTERIOR PLASTERING	m2	266,0	6,65	6,65	1.768,90	1.768,90
EXTERNAL COVERINGS OR PAINT	m2	266,0	6,00	30,00	1.596,00	7.980,00
WALL INSULATION	m2	137,0	20,27	20,27	2.776,99	2.776,99
ROOF FRAMING	m2	94,0	12,38	26,64	1.163,72	2.504,16
ROOF COVERING	m2	94,0	25,00	40,00	2.350,00	3.760,00
ROOF HEAT INSULATION	m2	94,0	7,73	20,27	726,62	1.905,38
ENTRTANCE DOOR(100/210)	pieces	1,0	480,00	1.350,00	480,00	1.350,00
ELECTRICITY	pieces	1,0	2.648,65	3.940,12	2.648,65	3.940,12
MECHANICAL	pieces	1,0	2.118,92	3.152,09	2.118,92	3.152,09
HEATING	pieces	1,0	3.178,38	4.728,14	3.178,38	4.728,14
GENERAL EXPENSES	pieces	1,0	2.648,65	3.940,12	2.648,65	3.940,12

Table 5.4 (continued) Project 4 Cost Calculations

LIVING ROOM SPECIFIC COST ITEMS, Area = 17 m2						
PAINT	m2	33,0	2,75	3,25	90,75	107,25
INTERNAL PLASTER	m2	33,0	5,06	5,06	166,98	166,98
WINDOWS (150/160) with 2(60/160)	pieces	1,0	493,00	677,00	493,00	677,00
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	15,0	13,00	42,00	195,00	630,00
KITCHEN SPECIFIC COST ITEMS, Area = 12 m2						
PAINT	m2	29,0	2,75	3,25	79,75	94,25
INTERNAL PLASTER	m2	29,0	5,06	5,06	146,74	146,74
WINDOWS (130/130)	pieces	1,0	187,00	198,00	187,00	198,00
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	9,9	24,00	38,00	237,60	376,20
KITCHEN CABINETS	pieces	1,0	2.145,00	2.850,00	2.145,00	2.850,00
BATHROOM SPECIFIC COST ITEMS, Area = 15 m2						
CERAMIC WALL COVERINGS	m2	69,0	16,00	30,00	1.104,00	2.070,00
INTERNAL PLASTER	m2	69,0	5,06	5,06	349,14	349,14
WINDOWS (60/60)	pieces	3,0	90,00	107,00	270,00	321,00
DOORS (90/210)	pieces	2,0	225,00	450,00	450,00	900,00
FLOOR COVERING	m2	12,3	16,00	30,00	196,80	369,00
BATHROOM ACC	pieces	1,0	1.938,00	2.780,00	1.938,00	2.780,00

Table 5.4 (continued) Project 4 Cost Calculations

BEDROOM SPECIFIC COST ITEMS, Area = 57 m2						
PAINT	m2	123,0	2,75	3,25	338,25	399,75
INTERNAL PLASTER	m2	123,0	5,06	5,06	622,38	622,38
WINDOWS (140/160) with 2(60/160)	pieces	2,0	470,00	655,00	940,00	1.310,00
WINDOWS (150/160) with 2(60/160)	pieces	1,0	493,00	677,00	493,00	677,00
WINDOWS (130/130)	pieces	1,0	187,00	198,00	187,00	198,00
DOORS (90/210)	pieces	3,0	225,00	450,00	675,00	1.350,00
FLOOR COVERING	m2	48,0	7,50	20,00	360,00	960,00
ENTRANCE & CORRIDORS SPECIFIC COST ITEMS, Area = 35 m2						
PAINT	m2	81,0	2,75	3,25	222,75	263,25
INTERNAL PLASTER	m2	81,0	5,06	5,06	409,86	409,86
WINDOWS (60/130)	pieces	4,0	213,00	291,00	852,00	1.164,00
DOORS (100/210)	pieces	0,5	240,00	480,00	120,00	240,00
DOORS (90/210)	pieces	3,5	225,00	450,00	787,50	1.575,00
FLOOR COVERING	m2	30,0	13,00	22,00	390,00	660,00
BALCONY SPECIFIC COST ITEMS, Area = 6 m2						
DOORS (100/210)	pieces	0,5	240,00	480,00	120,00	240,00
FLOOR COVERING	m2	4,7	12,00	20,00	56,40	94,00

Table 5.4 (continued) Project 4 Cost Calculations

STORAGE ROOM SPECIFIC COST ITEMS, Area = 4 m2						
PAINT	m2	19,0	2,75	3,25	52,25	61,75
INTERNAL PLASTER	m2	19,0	5,06	5,06	96,14	96,14
WINDOWS (60/60)	pieces	1,0	90,00	107,00	90,00	107,00
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	3,4	7,50	13,00	25,50	44,20
				TOTAL COST	***53.003,04***	***78.952,33***
				OVERALL UNIT COST	***365,54***	***544,50***

Table 5.5 Project 5 Cost Calculations

GENERAL PART: Total Construction Area = 393 m2			***UNIT COST (YTL/unit)***		***TOTAL COST (YTL)***	
WORK ITEMS	***UNIT***	***AMOUNT***	***MINIMUM***	***MAXIMUM***	***MINIMUM***	***MAXIMUM***
EXCAVATION	m3	171,0	1,27	7,62	217,17	1.303,02
FILL	m3	103,0	2,39	2,39	246,17	246,17
BLINDING CONCRETE	m3	21,0	50,03	57,32	1.050,63	1.203,72
BLOCKAGE	m3	31,5	21,10	26,16	664,65	824,04
WATERPROOF INSULATION	m2	210,0	10,50	13,70	2.205,00	2.877,00
CONCRETE	m3	149,3	58,82	62,32	8.781,83	9.304,38
REINFORCEMENT	tons	13,4	865,15	940,85	11.593,01	12.607,39
FORMWORK-SLAB	m2	159,0	4,50	5,85	715,50	930,15
FORMWORK-OTHERS	m2	352,0	8,73	11,89	3.072,96	4.185,28
FORMWORK SCAFFOLDING	m3	490,0	1,51	1,51	739,90	739,90
SCAFFOLDING FOR PAINT	m2	377,0	1,86	1,86	701,22	701,22
25 cm HOLLOW CEMENT BLOCK	m2	239,0	27,06	27,06	6.467,34	6.467,34
10 cm HOLLOW CEMENT BLOCK	m2	160,0	13,53	13,53	2.164,80	2.164,80
PLASTERING - SLABS -	m2	287,0	4,85	4,85	1.391,95	1.391,95
WHITE WASH - SLABS -	m2	287,0	0,77	0,77	220,99	220,99
EXTERIOR PLASTERING	m2	337,0	6,65	6,65	2.241,05	2.241,05
EXTERNAL COVERINGS OR PAINT	m2	337,0	6,00	30,00	2.022,00	10.110,00
WALL INSULATION	m2	239,0	20,27	20,27	4.844,53	4.844,53
ROOF FRAMING	m2	213,0	12,38	26,64	2.636,94	5.674,32
ROOF COVERING	m2	213,0	25,00	40,00	5.325,00	8.520,00
ROOF HEAT INSULATION	m2	213,0	7,73	20,27	1.646,49	4.317,51
ENTRTANCE DOOR(110/210)	pieces	1,0	500,00	1.450,00	500,00	1.450,00
ELECTRICITY	pieces	1,0	5.462,12	7.846,70	5.462,12	7.846,70
MECHANICAL	pieces	1,0	4.369,70	6.277,36	4.369,70	6.277,36
HEATING	pieces	1,0	6.554,54	9.416,04	6.554,54	9.416,04
GENERAL EXPENSES	pieces	1,0	5.462,12	7.846,70	5.462,12	7.846,70

Table 5.5 (continued) Project 5 Cost Calculations

LIVING ROOM SPECIFIC COST ITEMS, Area = 85 m2						
PAINT	m2	130,0	2,75	3,25	357,50	422,50
INTERNAL PLASTER	m2	130,0	5,06	5,06	657,80	657,80
WINDOWS (150/170)	pieces	3,0	277,00	391,00	831,00	1.173,00
WINDOWS (150/150)	pieces	1,0	221,00	310,00	221,00	310,00
WINDOWS (90/220)	pieces	1,0	235,00	324,00	235,00	324,00
WINDOWS (100/210)	pieces	1,0	224,00	316,00	224,00	316,00
DOORS (80/210)	pieces	1,0	210,00	420,00	210,00	420,00
DOORS (90/210)	pieces	2,0	225,00	450,00	450,00	900,00
FLOOR COVERING	m2	75,0	13,00	42,00	975,00	3.150,00
KITCHEN SPECIFIC COST ITEMS, Area = 14 m2						
PAINT	m2	32,0	2,75	3,25	88,00	104,00
INTERNAL PLASTER	m2	32,0	5,06	5,06	161,92	161,92
WINDOWS (150/150)	pieces	1,0	221,00	310,00	221,00	310,00
FLOOR COVERING	m2	12,2	24,00	38,00	292,80	463,60
KITCHEN CABINETS	pieces	1,0	3.470,00	4.650,00	3.470,00	4.650,00
BATHROOM SPECIFIC COST ITEMS, Area = 19 m2						
CERAMIC WALL COVERINGS	m2	78,0	16,00	30,00	1.248,00	2.340,00
INTERNAL PLASTER	m2	78,0	5,06	5,06	394,68	394,68
WINDOWS (50/50)	pieces	3,0	59,00	89,00	177,00	267,00
WINDOWS (40/90)	pieces	2,0	75,00	111,00	150,00	222,00
DOORS (90/210)	pieces	2,0	225,00	450,00	450,00	900,00
FLOOR COVERING	m2	17,2	16,00	30,00	275,68	516,90
BATHROOM ACC	pieces	1,0	3.133,00	5.030,00	3.133,00	5.030,00

Table 5.5 (continued) Project 5 Cost Calculations

BEDROOM SPECIFIC COST ITEMS, Area = 116 m2						
PAINT	m2	263,0	2,75	3,25	723,25	854,75
INTERNAL PLASTER	m2	263,0	5,06	5,06	1.330,78	1.330,78
WINDOWS (40/90)	pieces	2,0	75,00	111,00	150,00	222,00
WINDOWS (150/170)	pieces	4,0	277,00	391,00	1.108,00	1.564,00
WINDOWS (150/150)	pieces	2,0	221,00	310,00	442,00	620,00
DOORS (90/210)	pieces	4,0	225,00	450,00	900,00	1.800,00
FLOOR COVERING	m2	102,0	7,50	20,00	765,00	2.040,00
ENTRANCE & CORRIDORS SPECIFIC COST ITEMS, Area = 67 m2						
PAINT	m2	179,0	2,75	3,25	492,25	581,75
INTERNAL PLASTER	m2	179,0	5,06	5,06	905,74	905,74
WINDOWS (60/60)	pieces	1,0	90,00	106,00	90,00	106,00
DOORS (90/210)	pieces	4,5	225,00	450,00	1.012,50	2.025,00
DOORS (80/210)	pieces	1,0	210,00	420,00	210,00	420,00
FLOOR COVERING	m2	59,0	13,00	22,00	766,35	1.296,90
BALCONY SPECIFIC COST ITEMS, Area = 24 m2						
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
FLOOR COVERING	m2	20,8	12,00	20,00	249,96	416,60
TERRACE SPECIFIC COST ITEMS, Area = 69 m2						
FLOOR COVERING	m2	69,0	16,00	24,00	1.104,00	1.656,00
ROOF TERRACE	m2	64,0	30,00	45,00	1.920,00	2.880,00
DOORS (90/210)	pieces	0,5	225,00	450,00	112,50	225,00
				TOTAL COST	***108.997,29***	***157.099,08***
				GENERAL UNIT COST	***277,35***	***399,74***

5.2 UNIT AREA COST CALCULATIONS AND COMMENTING ON THE RESULTS

Overall unit area cost of the construction was found for each project in Chapter 5.1. It can be seen that, when the total area of the construction becomes larger, unit area cost tends to become smaller.

Projects 2 and 5 have the largest total areas. But, as it is seen in the drawings which can be found in appendix G, project 2 has same floor plans for the ground and 1st floor. In the construction, these types of architectural drawings are faced frequently. Main purpose for this type of architectural plan is to provide a house at each floor. Sometimes, villas are used as apartment buildings, one family living in each floor. One relative will live in one floor and the other relative in other floor. So, there are two kitchens, two living rooms and etc. Total area of this project is large. However, since the drawings are like two same floors, effect of total area on unit area cost can not be seen. However, in project 5 this effect can be seen very easily. Drawings of this house are like the ordinary projects and have one kitchen and so on but only difference is that, its area is larger. So, decreasing effect of total area of construction on the unit cost can be seen better in this project.

As explained earlier, a unit cost for the general part of the construction was calculated and also unit area costs for the specific rooms were found. After that, total unit area costs for different type of rooms were found by adding general unit area cost with the specific unit area cost. Results were found for each project, and results can be seen in the following tables

Table 5.6 Project 1 Unit Area Costs (YTL/m^2)

UNIT AREA COSTS (1) *Total Area = 258 m^2*		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	279	416
KITCHEN	500	649
BATHROOM	615	928
BEDROOM	284	411
ENTRANCE & CORRIDORS	302	445
STORAGE ROOM	326	466
BALCONY	258	378
TERRACE	293	424
WHOLE HOUSE	**323**	**469**

Table 5.7 Project 2 Unit Area Costs (YTL/m^2)

UNIT AREA COSTS (2) *Total Area = 326 m^2*		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	254	379
KITCHEN	516	655
BATHROOM	518	785
BEDROOM	263	380
ENTRANCE & CORRIDORS	296	444
STORAGE ROOM	NA	NA
BALCONY	258	387
TERRACE	251	358
WHOLE HOUSE	**301**	**432**

Table 5.8 Project 3 Unit Area Costs (YTL/m^2)

UNIT AREA COSTS (3) *Total Area = 236 m^2*		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	274	416
KITCHEN	448	600
BATHROOM	501	750
BEDROOM	277	406
ENTRANCE & CORRIDORS	290	436
STORAGE ROOM	NA	NA
BALCONY	249	369
TERRACE	264	380
WHOLE HOUSE	**308**	**450**

Table 5.9 Project 4 Unit Area Costs (YTL/m^2)

UNIT AREA COSTS (4) *Total Area = 145 m^2*		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	323	491
KITCHEN	503	709
BATHROOM	548	837
BEDROOM	324	481
ENTRANCE & CORRIDORS	340	508
STORAGE ROOM	355	518
BALCONY	290	440
TERRACE	NA	NA
WHOLE HOUSE	**366**	**544**

Table 5.10 Project 5 Unit Area Costs (YTL/m^2)

UNIT AREA COSTS (5) *Total Area = 393 m^2*		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	255	375
KITCHEN	509	696
BATHROOM	514	798
BEDROOM	249	355
ENTRANCE & CORRIDORS	259	369
STORAGE ROOM	NA	NA
BALCONY	222	316
TERRACE	252	358
WHOLE CONSTRUCTION	**277**	**400**

Effect of total area of construction on the unit area cost can be seen very easily in Tables 5.11 and 5.12. Project 2 and project 5 are the biggest projects and also they have the smallest unit area costs. Project 4 is the smallest, and it has the largest unit area cost. Another reason why project 4 costs higher is that there is no terrace in project 4. Terrace areas cost less and without terrace overall unit area cost will be more.

After some general comments on the overall unit area costs, it would be better to focus on the specific unit area costs. In table 5.11 and 5.12, spaces were sorted according to their unit area costs and all the projects results were put together and the average unit area costs were obtained.

Table 5.11 Minimum unit area costs of the projects

SPACES	MINIMUM UNIT AREA COST (YTL/m^2)					
	1	2	3	4	5	AVG
BATHROOM	615	518	501	548	514	539
KITCHEN	500	516	448	503	509	495
ENTRANCE & CORRIDORS	302	296	290	340	259	297
LIVING ROOM	279	254	274	323	255	277
BEDROOM	284	263	277	324	249	279
TERRACE	293	251	264	NA	252	265
BALCONY	258	258	249	290	222	255
WHOLE HOUSE	**323**	**301**	**308**	**366**	**277**	**315**

Table 5.12 Maximum unit area costs of the projects

SPACES	MAXIMUM UNIT AREA COST (YTL/m^2)					
	1	2	3	4	5	AVG
BATHROOM	928	785	750	837	798	820
KITCHEN	649	655	600	709	696	662
ENTRANCE & CORRIDORS	445	444	436	508	369	440
LIVING ROOM	416	379	416	491	375	415
BEDROOM	411	380	406	481	355	407
TERRACE	424	358	380	NA	358	380
BALCONY	378	387	369	440	316	378
WHOLE HOUSE	**469**	**432**	**450**	**544**	**400**	**459**

The reason why living room unit costs were found low is that they have relatively larger areas for a single room. As a result, their perimeter, which affects paint and plastering costs, is reduced. To explain better, if there is one room with 40 m^2 and also, there are 2 rooms with a total of 40 m^2, plastering and paint requirements for the first room will be lower than the other two rooms. Also, generally there is one door for a room and when the area of the room is big, unit area cost of that room is reduced. This is why unit costs of storage rooms are higher than those of living rooms. Storage rooms are small and generally have one window and, also a door. Instead of low unit prices for the floor coverings, storage rooms cost more in area basis since, number and costs of doors and windows per unit area is more for storage rooms.

Results show that unit area costs of bedrooms are very close to those of living rooms. Floor covering costs of living rooms are more, whereas there are more doors and windows for a unit area of bedrooms. Also, plastering and other costs tend to be higher for the bedrooms. As a result, these opposite factors neutralize each other, and the unit area costs of bedrooms and living rooms are very close.

Unit area costs of kitchens and bathrooms were much higher than the other parts of the projects. Kitchen cabinets were expensive and they increase the unit price of kitchens significantly. Generally, bathroom areas are small but they have washbasins, showers, closets and etc. These washbasins, closets and etc., increase the unit price of bathrooms and make it even higher than kitchen's unit area cost.

In project 1, there are 5 different bathrooms and their total area is not so big. As a result, unit area price was found very high. However, in project 5 there are 4 bathrooms and also one of the bathrooms is very big, which makes the total area of the bathrooms higher than the project 1. This results in a relatively low unit area cost for bathrooms in project 5. However, even in this project, unit area cost of bathrooms was higher than unit area cost of kitchens.

Unit area cost of entrance and corridors were found higher than the unit area costs of bedrooms and living rooms. Floor covering was not cheap for entrance and corridors and also perimeter of these rooms of the construction was high. Moreover, there were more doors for the unit area in the entrance and corridors. These were the reasons why entrance and corridors unit area price costs more.

Balcony costs were the lowest costs. Windows were not included for specific cost calculations of the balconies and also there was no plastering and paint costs. Situations, mentioned above, were same for the terrace cost calculations. Terrace costs were found as lower than other parts too. Terrace and balcony costs were very close, which is logical.

All the results were consistent. There was no illogical result. However, storage area can be disregarded in the final model, since generally storage areas are very small and using living room unit costs for the storage areas will not introduce serious error in the cost estimation of the housing project. Another reason behind this is that, even if the area of the storage rooms are big, the unit area cost for the storage rooms in that case, will be like the unit cost of the living room or maybe even smaller. (Effect of area on the unit cost described earlier) As a result, it can be said that if the storage room is small, using living room's unit area cost for the storage area, will not introduce any significant error, and if the storage areas are bigger, using living room's unit area cost for these areas, will provide more accurate results.

CHAPTER 6

MODEL DEVELOPMENT AND DISCUSSIONS

It was found more useful and suitable to disregard storage area in the final model. Reason behind this was explained in the previous section. Averages of the minimum and maximum unit area costs for each of the remaining types of rooms were found. In other words, for example, minimum kitchen unit area cost was found by averaging minimum unit area cost of kitchens of all of the projects. Also, standard deviations and the coefficient of variations were found to see the variances. Following tables show the results.

Table 6.1 Average Unit Area Costs

AVERAGE UNIT AREA COSTS	**YTL/m^2**	
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	277	415
BEDROOM	279	407
KITCHEN	495	662
BATHROOM	539	820
ENTRANCE & CORRIDORS	297	440
BALCONY	255	378
TERRACE	265	380
WHOLE HOUSE	***315***	***459***

Table 6.2 Standard Deviations of the Results

STANDARD DEVIATIONS	**YTL/m^2**	
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	28	47
BEDROOM	28	47
KITCHEN	27	43
BATHROOM	46	68
ENTRANCE & CORRIDORS	29	49
BALCONY	24	44
TERRACE	20	31
WHOLE HOUSE	***33***	***54***

Table 6.3 Coefficient of Variations of the Results

COEFFICIENT OF VARIATIONS		
ROOM TYPE	**MIN**	**MAX**
LIVING ROOM	0,101	0,112
BEDROOM	0,101	0,117
KITCHEN	0,055	0,065
BATHROOM	0,085	0,083
ENTRANCE & CORRIDORS	0,098	0,112
BALCONY	0,095	0,117
TERRACE	0,074	0,081
WHOLE CONSTRUCTION	***0,104***	***0,118***

It can be seen that variations are not very much despite the fact that, projects used for the model was chosen different so that better results can be obtained. Also, it can be seen that, coefficient of variation of the specific parts of the construction is smaller than the coefficient of variation for the whole construction. As a result of this, it can be said that, model will give more accurate results than a model, which only considers the total area of the construction.

Finally, following models were obtained for the conceptual cost estimation of 2 story housing projects. First formula is for the minimum estimate, and the second one is for the maximum estimate.

$$C_{MIN} = 277 \times LR + 279 \times BED + 495 \times K + 539 \times BR + 297 \times EC + 255 \times B + 265 \times T \ldots (1)$$

$$C_{MAX} = 415 \times LR + 407 \times BED + 662 \times K + 820 \times BR + 440 \times EC + 378 \times B + 380 \times T \ldots (2)$$

C_{MIN}: Minimum estimated cost of the housing project in YTL

C_{MAX}: Maximum estimated cost of the housing project in YTL

LR: Total living room area of the construction

BED: Total bedroom area of the construction

K: Total kitchen area of the construction

BR: Total bathroom area of the construction

EC: Total entrance and corridors area of the construction

B: Total balcony area of the construction

T: Total terrace area of the construction

Final models contain seven variables and are very simple. Model can be used even by the ordinary, uneducated people. Another advantage is that, model does not require any detailed information. This is very important since the model will be used in the feasibility stage of the construction, where there is very limited information about the project.

Ministry of Public Works and Settlement had given average of 406 ytl/m^2 unit area cost for villa constructions, as can be seen in 2005 Unit Price Analysis book [2]. However, this price includes contractor's profit of 25%. When profit amount was deducted, the unit price was found as 325ytl/m^2. It was well known from every person in construction business that the unit prices given by this analysis is low.

Minimum average unit price for whole construction was found as, 315 ytl/m2 in this thesis. This result is very close to the unit price given by Ministry of Public Works and Settlement. It would be better to remember that price given by the ministry is average, whereas our price is the minimum. As a result of these, it can be said that minimum unit price found, is consistent.

Feedbacks were taken from several companies about the maximum unit price obtained. Positive feedbacks were taken from Eser Müşavirlik Mühendislik A.Ş. and Metiş İnşaat ve Ticaret A.Ş. It can be concluded that, this model can be used for the conceptual cost estimation of housing projects in Ankara. Also, it can be used in any other city of the Turkey but results will be less accurate.

In the detailed discussions about the model it would be suitable to investigate the unit area costs of different type of rooms. Bathroom cost is the maximum unit cost. Also, kitchen cost is the runner up, which was predicted. Entrance and corridors cost was found higher than the living room costs due to high number of doors for unit area in the entrance and corridors. Living room and bedroom costs, and also the balcony and terrace costs were found almost same, which is again logical. Also, balcony and terrace cost was found as minimum. Balconies and terraces are the outer structures of the construction and they tend to cost less. Sorting of the average unit area prices can be found on table 6.4

To see the application assume there are 2 projects with total area of 200 m^2. 1st project has the following functional areas; living room: 40m^2, kitchen 25 m^2, bathroom: 20 m^2, bedroom: 85 m^2, entrance and corridors: 20 m^2 and terrace: 10 m^2. Estimates of model for this project are 66,540 YTL for the minimum and 96,745 YTL for the maximum. 2nd project has the following functional areas; living room: 40m^2, kitchen 15 m^2, bathroom: 10 m^2, bedroom: 85 m^2, entrance and corridors: 15 m^2 and terrace: 35 m^2. Estimates of model for this project are 61,340 YTL for the minimum and 89,225 YTL for the maximum. If the contractor will construct 20 houses, difference between maximum estimates of the projects is around 150,000 YTL which is significant. This example shows the importance of considering functional areas in the model.

Table 6.4 Average unit area costs of spaces in descending order

	AVERAGE UNIT AREA COSTS (YTL/m^2)	
SPACES	***MIN***	***MAX***
BATHROOM	539	820
KITCHEN	495	662
ENTRANCE & CORRIDORS	297	440
BEDROOM	279	407
LIVING ROOM	277	415
TERRACE	265	380
BALCONY	255	378
WHOLE HOUSE	**315**	**459**

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

Both of the cost estimation models can be used for 2 story villa constructions in Ankara. Estimator can find both the minimum and maximum cost of the housing project. Estimator should decide on which price to choose, by considering the quality of the project and demand of the clients or the contractors. Moreover, average of the minimum and maximum prices obtained from the models can be used for the estimated price.

This model should be used for 2 story housing constructions. However, it can be used for plans having basement and attic room. In that case, as explained earlier in detail, model will give higher estimates.

Pricing was performed by considering the market conditions in Ankara. Model will give more accurate results in this region. However, it can be used in other regions by considering the possible variances of the unit costs of some of the most important activities of the construction. For example, concrete, reinforcement and bathroom accessory costs can be found in the region of construction and can be compared with the Ankara conditions and a percentage price change can be obtained. By this way possible variances can be taken into account. Another thing to consider can be the variances of the labor costs.

It should not be used for extraordinary cases. Total area of construction for the data of this model was between 140 and 400 m^2. The cost estimation of projects in this range will be much more accurate.

It should be reminded that this model should not be used for apartment type building constructions where the total area of construction is much bigger than the total area for house constructions. However, it can give some idea about the costs even for

building constructions. But probably estimates will be higher. As the total area of construction increases unit area cost tends to decrease. It can be said that models result will not be accurate for big residential projects.

This model is for cost estimation at the conceptual stage. Conceptual estimation is performed in the feasibility stage where there is little information about the project. When detailed drawings are available, this model should not be used. Detailed estimates should be performed for further budget preparations and cash flow predictions.

Another useful result of the model would be to use this model before the preparation of the architectural drawings. For example, a contractor can have a specified limit of budget for a housing project. To remain in this budget, contractor can decide on the total area of the project and also, they can decide on the distribution of the areas of the several types of rooms. For example, total area of the construction can remain constant, but to stay within the budget, contractor can decrease the area of the kitchen and increase the area of the bedrooms to have lower overall cost.

It should be noted that, results are without value added tax and the profit of the contractor. This study is basically for the contractors so it is better not to add profit for the contractors. Also, value added tax should be regarded separately and it is not a cost in accounting point of view. However, VAT 18% and contractors profit around 25% can be added to the results for ordinary people interested in construction costs for their house projects. Also it should be reminded that, this study was performed using 2005 prices and by considering the inflation it can be used for the constructions in future years.

As a conclusion, simple and accurate model was prepared for villa constructions in Ankara. Contractors can use this model for conceptual cost estimation. Also, ordinary people can use this model to predict cost of their house project. In future studies, similar models can be developed for mass housing, residential apartment buildings, hospitals, and other structures.

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APPENDIX A

PROJECT 1 QUANTITY TAKE OFF

Table A.1. Excavation

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
1		1	145	0,75	108,8

Table A.2. Fill

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
1		0,6	145	0,75	65,3

Table A.3. Blinding Concrete

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
1		1	129,52	0,1	13,0

Table A.4. Blockage

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
1		1	129,52	0,15	19,4

Table A.5. Insulation at ground level

			AREA
PROJECT	UNIT	pieces	m2
1		1	129,52

Table A.6. Concrete

			TOTAL AREA	CONCRETE VOLUME
PROJECT	UNIT	pieces	m2	m3
1		1	258	98,0

Table A.7. Reinforcement

			TOTAL AREA	REINFORCEMENT AMOUNT
PROJECT	UNIT	pieces	m2	tons
1		1	258	8,8

Table A.8. Formwork

			TOTAL AREA	FORMWORK AREA
PROJECT	UNIT	pieces	m2	m2
1		1	258	670,8
			TWICE USAGE	335
		Slab Formwork	1	113
		Other Formwork	1	222

Table A.9. Slab Formwork Scaffolding

		HEIGHT	AREA	VOLUME
		m	m2	m3
Slab Formwork Scaffolding		2,68	113	302,84

Table A.10. Scaffolding for wall plastering

		HEIGHT	LENGTH	AREA
		m	m	m2
Scaffolding for Plastering		6,23	48,24	300,54

Table A.11. Entrance floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
1	ROOM 1	4	1,68	2,68	18,0	0,25	4,50
		1	1,36	2,68	3,6	0,25	0,91
		1	1,69	2,68	4,5	0,25	1,13
	VOID WINDOW	-4	0,8	1,5	-4,8	0,25	-1,20
	VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
	E23	1	2,11	2,68	5,7	0,25	1,41
	VOID DOOR	-2	0,8	2,1	-3,4	0,25	-0,84
	F12	1	4,3	2,68	11,5	0,25	2,88

Table A.11 (continued). Entrance floor Outer Walls

VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
1FB	1	4,55	2,68	12,2	0,25	3,05
VOID WINDOW	-3	0,5	0,7	-1,1	0,25	-0,26
1BA	1	3,25	2,68	8,7	0,25	2,18
A12	1	3,9	2,68	10,5	0,25	2,61
VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
A25	1	4,25	2,68	11,4	0,25	2,85
VOID WINDOW	-1	2,35	1,5	-3,5	0,25	-0,88
VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
5AC	1	6,15	2,68	16,5	0,25	4,12
VOID WINDOW	-1	2	1,5	-3,0	0,25	-0,75
TOTAL ENTARNCE				76,7		19,17

Table A.12. 1st floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
1	BR 1	4	1,68	2,68	18,0	0,25	4,50
		1	1,36	2,68	3,6	0,25	0,91
		1	1,69	2,68	4,5	0,25	1,13
		1	1,84	2,68	4,9	0,25	1,23
	VOID WINDOW	-4	0,8	1,5	-4,8	0,25	-1,20
	F23	1	2,11	2,68	5,7	0,25	1,41
	VOID WINDOW	-1	0,8	1,6	-1,3	0,25	-0,32
	F12	1	4,3	2,68	11,5	0,25	2,88
	VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
	1FB	1	4,55	2,68	12,2	0,25	3,05
	VOID WINDOW	-1	0,5	0,7	-0,4	0,25	-0,09
	1BA	1	3,25	2,68	8,7	0,25	2,18
	VOID WINDOW	-1	0,5	0,7	-0,4	0,25	-0,09
	A12	1	3,9	2,68	10,5	0,25	2,61
	VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
	BR 3	1	0,95	2,68	2,5	0,25	0,64
	VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
	BR 2	1	4,04	2,68	10,8	0,25	2,71
		1	1,25	2,68	3,4	0,25	0,84
		1	3,09	2,68	8,3	0,25	2,07
	VOID WINDOW	-1	2	1,5	-3,0	0,25	-0,75
	VOID WINDOW	-1	2,35	1,5	-3,5	0,25	-0,88
	VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
	TOTAL 1ST				83,1		20,77

Table A.13. Entrance Floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
1	3EC	1	2,45	2,68	6,6	0,1	0,66
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	C35	1	1,84	2,68	4,9	0,1	0,49
	C3-B2	1	2,75	2,68	7,4	0,1	0,74
	VIOD DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	2AB	1	3,25	2,68	8,7	0,1	0,87
	B12	1	4,25	2,68	11,4	0,1	1,14
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 1	2	2,1	2,68	11,3	0,1	1,13
		1	1,47	2,68	3,9	0,1	0,39
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	WC1	1	2,15	2,68	5,8	0,1	0,58
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	2ED	1	1,98	2,68	5,3	0,1	0,53
	TOTAL				53,9		5,39

Table A.14. 1st floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
1	3EC	1	2,45	2,68	6,6	0,1	0,66
	VOID DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	BATHROOM 2	1	2,29	2,68	6,1	0,1	0,61
	ENTRANCE	1	2,23	2,68	6,0	0,1	0,60
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	STAIRCASE	1	2,9	2,68	7,8	0,1	0,78
	BR 4	1	3,8	2,68	10,2	0,1	1,02
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BR 4	1	3,3	2,68	8,8	0,1	0,88
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 3	1	1	2,68	2,7	0,1	0,27
	B12	1	4,25	2,68	11,4	0,1	1,14
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 4	1	1	2,68	2,7	0,1	0,27
	BATHROOM 4	1	3,1	2,68	8,3	0,1	0,83
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	2AB	1	2,05	2,68	5,5	0,1	0,55
	B2-C3	1	2,75	2,68	7,4	0,1	0,74
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	TOTAL				68,3		6,83

Table A.15. White Wash for Slab

			AREA
INFO	UNIT	pieces	m2
1st FLOOR		1	97,52
ROOF SLAB		1	97,14
TOTAL WHITE WASH AREA			195

Table A.16. Plastering for Outer Walls

			LENGTH	HEIGHT	AREA
PROJECT		pieces	m	m	m2
1	FLOOR 1	1	48,24	3,55	171,3
	VOID WINDOW	-4	0,8	1,5	-4,8
	VOID WINDOW	-3	0,5	0,7	-1,1
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	2,35	1,5	-3,5
	VOID WINDOW	-1	2	1,5	-3,0
	VOID DOOR	-5	0,9	2,1	-9,5
	FLOOR 2	1	45,61	2,68	122,2
	VOID WINDOW	-4	0,8	1,5	-4,8
	VOID WINDOW	-1	0,8	1,6	-1,3
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	0,5	0,7	-0,4
	VOID WINDOW	-1	0,5	0,7	-0,4
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	2	1,5	-3,0
	VOID WINDOW	-1	2,35	1,5	-3,5
	VOID DOOR	-2	0,9	2,1	-3,8
	TOTAL				245,6

Table A.17. Roof Projection Area & Roof Insulation

			AREA
PROJECT	UNIT	pieces	m2
1		1	138,98

Table A.18. Living Room Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
1		1	53,47

Table A.19. Living Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	LIVING ROOM	1	20,7	2,68	55,48
	VOID WINDOW	-1	2,35	1,5	-3,53
	VOID WINDOW	-1	2	1,5	-3,00
	VOID DOOR	-3	0,9	2,1	-5,67
	ROOM 1	1	19,26	2,68	51,62
	VOID WINDOW	-4	0,8	1,5	-4,80
	VOID DOOR	-2	0,9	2,1	-3,78
	TOTAL				86,32

Table A.20. Living Room Doors

PROJECT	INFO	PIECES
1	LIVING ROOM	3
	ROOM 1	2
	TOTAL	5

Table A.21. Living Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	LIVING ROOM	1	2,35	1,5
	LIVING ROOM	1	2	1,5
	ROOM 1	4	0,8	1,5

Table A.22. Kitchen Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
1		1	15,94

Table A.23. Kitchen Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	KITCHEN	1	16	2,68	42,88

Table A.23 (continued). Kitchen Wall Paint Area

VOID WINDOW	-1	1,5	1,5	-2,25
VOID DOOR	-2	0,9	2,1	-3,78
TOTAL				36,85

Table A.24. Kitchen Doors

PROJECT	INFO	PIECES
1	KITCHEN	2

Table A.25. Kitchen Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	KITCHEN	1	1,5	1,5

Table A.26. Bathroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	BATHROOM 1	1	2,74
	WC 1	1	2,25
	BATHROOM 2	1	3,6
	BATHROOM 3	1	3,2
	BATHROOM 4	1	3
	TOTAL		14,79

Table A.27. Bathroom Wall Covering Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	BATHROOM 1	1	6,74	2,68	18,06
	VOID WINDOW	-1	0,5	0,7	-0,35
	VOID DOOR	-1	0,9	2,1	-1,89
	WC 1	1	6,39	2,68	17,13
	VOID WINDOW	-1	0,5	0,7	-0,35
	VOID DOOR	-1	0,9	2,1	-1,89

Table A.27 (continued). Bathroom Wall Covering Area

BATHROOM 2	1	8,83	2,68	23,66
VOID WINDOW	-1	0,5	0,7	-0,35
VOID DOOR	-1	0,9	2,1	-1,89
BATHROOM 3	1	8,39	2,68	22,49
VOID WINDOW	-1	0,5	0,7	-0,35
VOID DOOR	-1	0,9	2,1	-1,89
BATHROOM 4	1	8	2,68	21,44
VOID WINDOW	-1	0,8	1,6	-1,28
VOID DOOR	-1	0,9	2,1	-1,89
TOTAL				90,65

Table A.28. Bathroom Doors

PROJECT	INFO	pieces
1	BATHROOM 1	1
	WC 1	1
	BATHROOM 2	1
	BATHROOM 3	1
	BATHROOM 4	1
	TOTAL	5

Table A.29. Bathroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	BATHROOM 1	1	0,5	0,7
	WC 1	1	0,5	0,7
	BATHROOM 2	1	0,8	1,6
	BATHROOM 3	1	0,5	0,7
	BATHROOM 4	1	0,5	0,7

Table A.30. Bedroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	BR 1	1	25,96
	BR 2	1	15,96
	BR 3	1	12,53
	BR 4	1	12,14
	TOTAL		66,59

Table A.31. Bedroom Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	BR 1	1	19,26	2,68	51,62
	VOID WINDOW	-4	0,8	1,5	-4,80
	VOID DOOR	-2	0,9	2,1	-3,78
	BR 2	1	16,19	2,68	43,39
	VOID WINDOW	-1	2,35	1,5	-3,53
	VOID WINDOW	-1	2	1,5	-3,00
	VOID DOOR	-2	0,9	2,1	-3,78
	BR 3	1	16	2,68	42,88
	VOID WINDOW	-1	1,5	1,5	-2,25
	VOID DOOR	-3	0,9	2,1	-5,67
	BR 4	1	14	2,68	37,52
	VOID WINDOW	-1	1,5	1,5	-2,25
	VOID DOOR	-2	0,9	2,1	-3,78
	TOTAL				142,57

Table A.32. Bedroom Doors

PROJECT	INFO	pieces
1	BR 1	2
	BR 2	2
	BR 3	3
	BR 4	2
	TOTAL	9

Table A.33. Bedroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	BR 1	4	0,8	1,5
	BR 2	1	2,35	1,5
	BR 2	1	2	1,5
	BR 3	1	1,5	1,5
	BR 4	1	1,5	1,5

Table A.34. Entrance and Corridors Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	FLOOR 1	1	19,46
	FLOOR 2	1	9,71
	TOTAL		29,17

Table A.35. Entrance and Corridors Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	FLOOR 1	1	22,35	2,68	59,90
	VOID DOOR	-9	0,9	2,1	-17,01
	VOID WINDOW	-1	1,5	1,5	-2,25
	FLOOR 2	1	16,86	2,68	45,18
	VOID DOOR	-5	0,9	2,1	-9,45
	TOTAL				76,37

Table A.36. Entrance and Corridors Doors

PROJECT	INFO	pieces
1	FLOOR 1	7
	FLOOR 2	5
	TOTAL	12

Table A.37. Entrance and Corridors Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	FLOOR 1	1	1,5	1,5

Table A.38. Storage Room Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	FLOOR 1	1	3,66
	FLOOR 2	1	1,23
	TOTAL		4,89

Table A.39. Storage Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
1	FLOOR 1	1	8,58	2,68	22,99
	VOID DOOR	-1	0,9	2,1	-1,89
	VOID WINDOW	-1	0,5	0,7	-0,35
	FLOOR 2	1	4,49	2,68	12,03
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				30,90

Table A.40. Storage Room Doors

PROJECT	INFO	PIECES
1	FLOOR 1	1
	FLOOR 2	1
	TOTAL	2

Table A.41. Storage Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
1	FLOOR 1	1	0,5	0,7

Table A.42. Terrace Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	TERRACE	1	32,28

Table A.43. Terrace Roof Projection Area

			AREA
PROJECT	UNIT	pieces	m2
1		1	41,56

Table A.44. Terrace Doors

PROJECT	INFO	PIECES
1	TERRACE	3

Table A.45. Balcony Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
1	TERRACE	1	9,81

Table A.46. Balcony Doors

PROJECT	INFO	PIECES
1		2

Table A.47. Entrance Door

		LENGHT	HEIGHT
PROJECT	pieces	m	m
1	2	0,8	2,1

APPENDIX B

PROJECT 2 QUANTITY TAKE OFF

Table B.1. Excavation

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
2		1	163,2	0,75	122,4

Table B.2. Fill

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
2		0,6	163,2	0,75	73,4

Table B.3. Blinding Concrete

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
2		1	151,78	0,1	15,2

Table B.4. Blockage

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
2		1	151,78	0,15	22,8

Table B.5. Insulation at ground level

			AREA
PROJECT	UNIT	pieces	m2
2		1	151,78

Table B.6. Concrete

			TOTAL AREA	CONCRETE VOLUME
PROJECT	UNIT	pieces	m2	m3
2		1	303,56	115,4

Table B.7. Reinforcement

			TOTAL AREA	REINFORCEMENT AMOUNT
PROJECT	UNIT	pieces	m2	tons
2		1	303,56	10,3

Table B.8. Formwork

			TOTAL AREA	FORMWORK AREA
PROJECT	UNIT	pieces	m2	m2
2		1	303,56	789,3
			TWICE USAGE	395
		Slab Formwork	1	163
		Other Formwork	1	232

Table B.9. Slab Formwork Scaffolding

		HEIGHT	AREA	VOLUME
		m	m2	m3
Slab Formwork Scaffolding		2,68	163	436,84

Table B.10. Scaffolding for wall plastering

		HEIGHT	LENGTH	AREA
		m	m	m2
Scaffolding for Plastering		6,1	52,4	319,64

Table B.11. Entrance floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
2	1CE	1	3,69	2,68	9,9	0,25	2,47
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1CD	1	2,7	2,68	7,2	0,25	1,81
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1BA	1	4,11	2,68	11,0	0,25	2,75
	A13	1	6,04	2,68	16,2	0,25	4,05
	VOID WINDOW	-1	2,4	1,6	-3,8	0,25	-0,96
	VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
	A34	1	2,96	2,68	7,9	0,25	1,98
	VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
	VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50

Table B.11 (continued). Entrance floor Outer Walls

4AB	1	4,21	2,68	11,3	0,25	2,82
VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
4BC	1	2,94	2,68	7,9	0,25	1,97
VOID DOOR	-1	1	2,2	-2,2	0,25	-0,55
4DE	1	3,45	2,68	9,2	0,25	2,31
VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
E24	1	5,8	2,68	15,5	0,25	3,89
VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
VOID WINDOW	-1	0,6	0,6	-0,4	0,25	-0,09
E12	1	3,3	2,68	8,8	0,25	2,21
VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
B34	1	2,56	2,68	6,9	0,25	1,72
D34	1	2,56	2,68	6,9	0,25	1,72
3BD	1	3,24	2,68	8,7	0,25	2,17
VOID DOOR	-1	1	2,2	-2,2	0,25	-0,55
TOTAL				100,3		25,07

Table B.12. 1st floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
2	1CE	1	3,69	2,68	9,9	0,25	2,47
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1CD	1	2,7	2,68	7,2	0,25	1,81
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1BA	1	4,11	2,68	11,0	0,25	2,75
	A13	1	6,04	2,68	16,2	0,25	4,05
	VOID WINDOW	-1	2,4	1,6	-3,8	0,25	-0,96
	VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
	A34	1	2,96	2,68	7,9	0,25	1,98
	VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
	VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
	4AB	1	4,21	2,68	11,3	0,25	2,82
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	4BC	1	2,94	2,68	7,9	0,25	1,97
	VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
	4DE	1	3,45	2,68	9,2	0,25	2,31
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	E24	1	5,8	2,68	15,5	0,25	3,89
	VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
	VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50

Table B.12 (continued). 1st floor Outer Walls

VOID WINDOW	-1	0,6	0,6	-0,4	0,25	-0,09
E12	1	3,3	2,68	8,8	0,25	2,21
VOID DOOR	-1	0,9	2,2	-2,0	0,25	-0,50
VOID WINDOW	-1	1	1,3	-1,3	0,25	-0,33
B34	1	2,56	2,68	6,9	0,25	1,72
D34	1	2,56	2,68	6,9	0,25	1,72
3BD	1	3,24	2,68	8,7	0,25	2,17
VOID DOOR	-1	1	2,2	-2,2	0,25	-0,55
TOTAL				101,2		25,30

Table B.13. Entrance Floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
2	3AB	1	4,96	2,68	13,3	0,1	1,33
	VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
	LIVING ROOM	1	2,64	2,68	7,1	0,1	0,71
	VOID DOOR	-2	0,8	2,2	-3,5	0,1	-0,35
	B12	1	3,65	2,68	9,8	0,1	0,98
	C12	1	3,3	2,68	8,8	0,1	0,88
	2BC	1	2,7	2,68	7,2	0,1	0,72
	VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
	ROOM 2	1	1,8	2,68	4,8	0,1	0,48
	VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
	BATHROOM 1	1	2	2,68	5,4	0,1	0,54
	VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
	BATHROOM 1	1	2,6	2,68	7,0	0,1	0,70
	BATHROOM 1 - WC1	1	6	2,68	16,1	0,1	1,61
	VOID DOOR	-2	0,9	2,2	-4,0	0,1	-0,40
	WC 1	2	1,34	2,68	7,2	0,1	0,72
	WC 1	1	0,7	2,68	1,9	0,1	0,19
	TOTAL				73,1		7,31

Table B.14. 1st floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
2	3AB	1	4,96	2,68	13,3	0,1	1,33
	VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
	LIVING ROOM 2	1	2,64	2,68	7,1	0,1	0,71
	VOID DOOR	-2	0,8	2,2	-3,5	0,1	-0,35
	B12	1	3,65	2,68	9,8	0,1	0,98

Table B.14 (continued). 1st floor Inner Walls

C12	1	3,3	2,68	8,8	0,1	0,88
2BC	1	2,7	2,68	7,2	0,1	0,72
VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
ROOM 5	1	1,8	2,68	4,8	0,1	0,48
VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
BATHROOM 1	1	2	2,68	5,4	0,1	0,54
VOID DOOR	-1	0,9	2,2	-2,0	0,1	-0,20
BATHROOM 1	1	2,6	2,68	7,0	0,1	0,70
BATHROOM 2 - WC 2	1	6	2,68	16,1	0,1	1,61
VOID DOOR	-2	0,9	2,2	-4,0	0,1	-0,40
WC 2	2	1,34	2,68	7,2	0,1	0,72
WC 2	1	0,7	2,68	1,9	0,1	0,19
TOTAL				73,1		7,31

Table B.15. White Wash for Slab

			AREA
INFO	UNIT	pieces	m2
1st FLOOR		1	151,78
ROOF SLAB		1	151,78
TOTAL WHITE WASH AREA			304

Table B.16. Plastering for Outer Walls

			LENGTH	HEIGHT	AREA
PROJECT		pieces	m	m	m2
2	FLOOR 1	1	52,4	3,3	172,9
	VOID WINDOW	-4	1,3	1,3	-6,8
	VOID WINDOW	-3	1	1,3	-3,9
	VOID WINDOW	-1	2,4	1,6	-3,8
	VOID WINDOW	-1	0,6	0,6	-0,4
	VOID DOOR	-4	0,9	2,2	-7,9
	VOID DOOR	-1	1	2,2	-2,2
	FLOOR 2	1	52,4	2,68	140,4
	VOID WINDOW	-4	1,3	1,3	-6,8
	VOID WINDOW	-3	1	1,3	-3,9
	VOID WINDOW	-1	2,4	1,6	-3,8
	VOID WINDOW	-1	0,6	0,6	-0,4
	VOID DOOR	-4	0,9	2,2	-7,9
	VOID DOOR	-1	1	2,2	-2,2
	TOTAL				263,4

Table B.17. Roof Projection Area & Roof Insulation

			AREA
PROJECT	UNIT	pieces	m2
2		1	170,8

Table B.18. Living Room Floor Covering Area

			AREA	TOTAL AREA
PROJECT	UNIT	pieces	m2	m2
2		2	29,87	59,74

Table B.19. Living Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
2	LIVING ROOM	2	23,2	2,68	124,35
	VOID WINDOW	-2	2,4	1,6	-7,68
	VOID DOOR	-6	0,9	2,2	-11,88
	TOTAL				104,79

Table B.20. Living Room Doors

PROJECT	INFO	PIECES
2	LIVING ROOM	3
	TOTAL	3
	TOTAL 2 ROOMS	6

Table B.21. Living Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
2	LIVING ROOM	2	2,4	1,6

Table B.22. Kitchen Floor Covering Area

			AREA	TOTAL AREA
PROJECT	UNIT	pieces	m2	m2
2		2	15,13	30,26

Table B.23. Kitchen Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
2	KITCHEN	2	16,04	2,68	85,97
	VOID WINDOW	-2	1	1,3	-2,60
	VOID WINDOW	-2	1,3	1,3	-3,38
	VOID DOOR	-4	0,9	2,2	-7,92
	TOTAL				72,07

Table B.24. Kitchen Doors

PROJECT	INFO	PIECES
2	KITCHEN	2
	TOTAL 2 ROOMS	4

Table B.25. Kitchen Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
2	KITCHEN	2	1	1,3
		2	1	1,3

Table B.26. Bathroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
2	BATHROOM 1	1	5
	WC 1	1	2,66
	BATHROOM 2	1	5
	WC 2	1	2,66
	TOTAL		15,32

Table B.27. Bathroom Wall Covering Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
2	BATHROOM 1	1	9	2,68	24,12
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-1	0,9	2,2	-1,98
	WC 1	1	8,16	2,68	21,87

Table B.27 (continued). Bathroom Wall Covering Area

VOID DOOR	-1	0,9	2,2	-1,98
BATHROOM 2	1	9	2,68	24,12
VOID WINDOW	-1	0,6	0,6	-0,36
VOID DOOR	-1	0,9	2,2	-1,98
WC 2	1	8,16	2,68	21,87
VOID DOOR	-1	0,9	2,2	-1,98
TOTAL				83,34

Table B.28. Bathroom Doors

PROJECT	INFO	pieces
2	BATHROOM 1	1
	WC 1	1
	BATHROOM 2	1
	WC 2	1
	TOTAL	4

Table B.29. Bathroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
2	BATHROOM 1	1	0,6	0,6
	BATHROOM 2	1	0,6	0,6
	WC 1	1	0,6	0,6
	WC 2	1	0,6	0,6

Table B.30. Bedroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
2	BR 1	1	10,26
	BR 2	1	15
	BR 3	1	17,1
	TOTAL		42,36
	TOTAL (2 FLOORS)		84,72

Table B.31. Bedroom Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
2	BR 1	1	13	2,68	34,84
	VOID WINDOW	-1	1,3	1,3	-1,69
	VOID DOOR	-1	0,9	2,2	-1,98
	BR 2	1	16,65	2,68	44,62
	VOID WINDOW	-1	1,3	1,3	-1,69
	VOID WINDOW	-1	1	1,3	-1,30
	VOID DOOR	-2	0,9	2,2	-3,96
	BR 3	1	16	2,68	42,88
	VOID WINDOW	-1	1,3	1,3	-1,69
	VOID WINDOW	-1	1	1,3	-1,30
	VOID DOOR	-2	0,9	2,2	-3,96
	TOTAL				104,77
	TOTAL (2 FLOORS)				209,54

Table B.32. Bedroom Doors

PROJECT	INFO	pieces
2	BR 1	1
	BR 2	2
	BR 3	2
	TOTAL	5
	TOTAL (2 FLOORS)	10

Table B.33. Bedroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
2	BR 1&4	2	1,3	1,3
	BR 2&5	2	1,3	1,3
	BR 2&5	2	1	1,3
	BR 3&6	2	1,3	1,3
	BR 3&6	2	1	1,3

Table B.34. Entrance and Corridors Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
2	FLOOR 1	1	20,4

Table B.34 (continued). Entrance and Corridors Floor Covering Area

FLOOR 2	1	20,4
TOTAL		40,8

Table B.35. Entrance and Corridors Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
2	FLOOR 1	1	27,86	2,68	74,66
	VOID DOOR	-6	0,9	2,2	-11,88
	VOID DOOR	-2	1	2,2	-4,40
	VOID DOOR	-2	0,8	2,2	-3,52
	FLOOR 2	1	27,86	2,68	74,66
	VOID DOOR	-2	1	2,2	-4,40
	VOID DOOR	-6	0,9	2,2	-11,88
	VOID DOOR	-1	1	2,2	-2,20
	VOID WINDOW	-1	1	1,3	-1,30
	TOTAL				109,75

Table B.36. Entrance and Corridors Doors

PROJECT	INFO	pieces
2	FLOOR 1	9
	FLOOR 2	9
	TOTAL	18

Table B.37. Entrance and Corridors Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
2	FLOOR 2	1	1	1,3

Table B.38. Terrace Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
2	TERRACE	2	30,6
	TOTAL		61,2

Table B.39. Terrace Roof Projection Area

			AREA
PROJECT	UNIT	pieces	m2
2		1	48,8

Table B.40. Terrace Doors

PROJECT	INFO	PIECES
2	TERRACE	2
	TOTAL	4

Table B.41. Balcony Floor Covering Area

			AREA	TOTAL AREA
PROJECT	INFO	pieces	m2	m2
2		4	2,88	11,52

Table B.42. Balcony Doors

PROJECT	INFO	PIECES
2		4

Table B.43. Entrance Door

		LENGHT	HEIGHT
PROJECT	pieces	m	m
2	1	1	2,2

APPENDIX C

PROJECT 3 QUANTITY TAKE OFF

Table C.1. Excavation

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
3		1	136,82	0,75	102,6

Table C.2. Fill

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
3		0,6	136,82	0,75	61,6

Table C.3. Blinding Concrete

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
3		1	123,8	0,1	12,4

Table C.4. Blockage

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
3		1	123,8	0,15	18,6

Table C.5. Insulation at ground level

			AREA
PROJECT	UNIT	pieces	m2
3		1	123,8

Table C.6. Concrete

			TOTAL AREA	CONCRETE VOLUME
PROJECT	UNIT	pieces	m2	m3
3		1	236,45	89,9

Table C.7. Reinforcement

			TOTAL AREA	REINFORCEMENT AMOUNT
PROJECT	UNIT	pieces	m2	tons
3		1	236,45	8,0

Table C.8. Formwork

			TOTAL AREA	FORMWORK AREA
PROJECT	UNIT	pieces	m2	m2
3		1	236,45	614,8
			TWICE USAGE	307
		Slab Formwork	1	137
		Other Formwork	1	170

Table C.9. Slab Formwork Scaffolding

		HEIGHT	AREA	VOLUME
		m	m2	m3
Slab Formwork Scaffolding		2,78	137	380,86

Table C.10. Scaffolding for wall plastering

		HEIGHT	LENGTH	AREA
		m	m	m2
Scaffolding for Plastering		6,43	49,1	315,71

Table C.11. Entrance floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
3	D12	1	3,8	2,78	10,6	0,25	2,64
	VOID WINDOW	-3	0,7	1,6	-3,4	0,25	-0,84
	D24	1	3,4	2,78	9,5	0,25	2,36
	VOID DOOR	-1	1	2,1	-2,1	0,25	-0,53
	4DE	1	0,9	2,78	2,5	0,25	0,63
	E46	1	3,3	2,78	9,2	0,25	2,29
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	6CE	1	2,95	2,78	8,2	0,25	2,05
	VOID WINDOW	-1	2	1,5	-3,0	0,25	-0,75
	5CA	1	4,15	2,78	11,5	0,25	2,88
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	A45	1	2,6	2,78	7,2	0,25	1,81

Table C.11 (continued). Entrance floor Outer Walls

A24	1	2,85	2,78	7,9	0,25	1,98
VOID WINDOW	-2	0,6	0,6	-0,7	0,25	-0,18
A12	1	4,15	2,78	11,5	0,25	2,88
VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
1AD	1	5,8	2,78	16,1	0,25	4,03
VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
TOTAL				76,1		19,03

Table C.12. 1st floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
3	D12	1	3,8	2,78	10,6	0,25	2,64
	VOID WINDOW	-3	0,7	1,6	-3,4	0,25	-0,84
	D24	1	3,4	2,78	9,5	0,25	2,36
	VOID WINDOW	-1	0,7	1,6	-1,1	0,25	-0,28
	VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
	4DE	1	0,9	2,78	2,5	0,25	0,63
	E46	1	3,3	2,78	9,2	0,25	2,29
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	6CE	1	2,95	2,78	8,2	0,25	2,05
	VOID WINDOW	-1	2	1,5	-3,0	0,25	-0,75
	5CA	1	4,15	2,78	11,5	0,25	2,88
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	A45	1	2,6	2,78	7,2	0,25	1,81
	A24	1	2,85	2,78	7,9	0,25	1,98
	VOID WINDOW	-2	0,6	0,6	-0,7	0,25	-0,18
	A12	1	4,15	2,78	11,5	0,25	2,88
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	1AD	1	5,8	2,78	16,1	0,25	4,03
	VOID WINDOW	-2	0,7	1,6	-2,2	0,25	-0,56
	TOTAL				75,2		18,80

Table C.13. Entrance Floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
3	4DC	1	1,3	2,78	3,6	0,1	0,36
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	4CA	1	4,5	2,78	12,5	0,1	1,25
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	KITCHEN	1	3,3	2,78	9,2	0,1	0,92
	WC	1	1,2	2,78	3,3	0,1	0,33

Table C.13 (continued). Entrance Floor Inner Walls

VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
BATHROOM 1	1	2,9	2,78	8,1	0,1	0,81
VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
BATHROOM 1	1	2,1	2,78	5,8	0,1	0,58
2AB	1	2,8	2,78	7,8	0,1	0,78
2CD	1	1,5	2,78	4,2	0,1	0,42
VOID DOOR	-1	1,15	2,1	-2,4	0,1	-0,24
TOTAL				44,5		4,45

Table C.14. 1st floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
3	4DC	1	1,3	2,78	3,6	0,1	0,36
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	4CA	1	4,5	2,78	12,5	0,1	1,25
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BEDROOM 2	1	3,3	2,78	9,2	0,1	0,92
	BATHROOM 2	1	3,3	2,78	9,2	0,1	0,92
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 2	1	2,8	2,78	7,8	0,1	0,78
	2AB	1	2,8	2,78	7,8	0,1	0,78
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	2CD	1	1,5	2,78	4,2	0,1	0,42
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	TOTAL				44,8		4,48

Table C.15. White Wash for Slab

			AREA
INFO	UNIT	pieces	m2
1st FLOOR		1	80,44
ROOF SLAB		1	85,73
TOTAL WHITE WASH AREA			166

Table C.16. Plastering for Outer Walls

			LENGTH	HEIGHT	AREA
PROJECT		pieces	m	m	m2
3	FLOOR 1	1	49,1	3,65	179,2
	VOID WINDOW	-11	0,7	1,6	-12,3
	VOID WINDOW	-2	0,6	0,6	-0,7

Table C.16 (continued). Plastering for Outer Walls

VOID WINDOW	-1	2	1,5	-3,0
VOID DOOR	-1	1	2,1	-2,1
FLOOR 2	1	43,1	2,78	119,8
VOID WINDOW	-11	0,7	1,6	-12,3
VOID WINDOW	-2	0,6	0,6	-0,7
VOID WINDOW	-1	2	1,5	-3,0
VOID DOOR	-1	0,9	2,1	-1,9
TOTAL				263,0

Table C.17. Roof Projection Area & Roof Insulation

			AREA
PROJECT	UNIT	pieces	m2
3		1	130,76

Table C.18. Living Room Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
3		1	29,25

Table C.19. Living Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
3	LIVING ROOM	1	22	2,78	61,16
	VOID WINDOW	-7	0,7	1,6	-7,84
	VOID DOOR	-1	1,15	2,1	-2,42
	TOTAL				50,91

Table C.20. Living Room Doors

PROJECT	INFO	PIECES
3	LIVING ROOM	1

Table C.21. Living Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
3	LIVING ROOM	7	0,7	1,6

Table C.22. Kitchen Floor Covering Area

			AREA	TOTAL AREA
PROJECT	UNIT	pieces	m2	m2
3		1	18,08	18,08

Table C.23. Kitchen Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
3	KITCHEN	1	17,6	2,78	48,93
	VOID WINDOW	-2	0,7	1,6	-2,24
	VOID WINDOW	-1	2	1,5	-3,00
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				41,80

Table C.24. Kitchen Doors

PROJECT	INFO	PIECES
3	KITCHEN	1

Table C.25. Kitchen Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
3	KITCHEN	1	2,2	1,5
		2	0,7	1,6

Table C.26. Bathroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
3	BATHROOM 1	1	6,2
	WC 1	1	2,04
	BATHROOM 2	1	5,04

Table C.26 (continued) Bathroom Floor Covering Area

BATHROOM 3	1	4,34
TOTAL		17,62

Table C.27. Bathroom Wall Covering Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
3	BATHROOM 1	1	9,9	2,78	27,52
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-1	0,9	2,1	-1,89
	WC 1	1	5,8	2,78	16,12
	VOID DOOR	-1	0,9	2,1	-1,89
	VOID WINDOW	-1	0,6	0,6	-0,36
	BATHROOM 2	1	9,2	2,78	25,58
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-1	0,9	2,1	-1,89
	BATHROOM 3	1	8,7	2,78	24,19
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				84,41

Table C.28. Bathroom Doors

PROJECT	INFO	pieces
3	BATHROOM 1	1
	WC 1	1
	BATHROOM 2	1
	BATHROOM 3	1
	TOTAL	4

Table C.29. Bathroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
3	BATHROOM 1	1	0,6	0,6
	WC 1	1	0,6	0,6
	BATHROOM 2	1	0,6	0,6
	BATHROOM 3	1	0,6	0,6

Table C.30. Bedroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
3	BR 1	1	11,55
	BR 2	1	14,65
	BR 3	1	14,81
	BR 4	1	29,25
	TOTAL		70,26

Table C.31. Bedroom Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
3	BR 1	1	13,6	2,78	37,81
	VOID WINDOW	-2	0,7	1,6	-2,24
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 2	1	15,6	2,78	43,37
	VOID WINDOW	-2	0,7	1,6	-2,24
	VOID WINDOW	-1	2	1,5	-3,00
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 3	1	16	2,78	44,48
	VOID WINDOW	-2	0,7	1,6	-2,24
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 4	1	22	2,78	61,16
	VOID WINDOW	-7	0,7	1,6	-7,84
	VOID DOOR	-2	0,9	2,1	-3,78
	TOTAL				159,81

Table C.32. Bedroom Doors

PROJECT	INFO	pieces
3	BR 1	1
	BR 2	1
	BR 3	1
	BR 4	2
	TOTAL	5

Table C.33. Bedroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
3	BR 1	2	0,7	1,6

Table C.33. (continued) Bedroom Windows

BR 2	2	0,7	1,6
BR 2	1	2,2	1,5
BR 3	2	0,7	1,6
BR 4	7	0,7	1,6

Table C.34. Entrance and Corridors Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
3	FLOOR 1	1	13,32
	FLOOR 2	1	11,97
	TOTAL		25,29

Table C.35. Entrance and Corridors Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
3	FLOOR 1	1	16,6	2,78	46,15
	VOID DOOR	-4	0,9	2,1	-7,56
	VOID DOOR	-1	1,15	2,1	-2,42
	VOID DOOR	-2	1	2,1	-4,20
	FLOOR 2	1	14,4	2,78	40,03
	VOID DOOR	-5	0,9	2,1	-9,45
	VOID WINDOW	-1	0,7	1,6	-1,12
	TOTAL				61,44

Table C.36. Entrance and Corridors Doors

PROJECT	INFO	pieces
3	FLOOR 1	5
	FLOOR 2	5
	TOTAL	10

Table C.37. Entrance and Corridors Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
3	FLOOR 2	1	0,7	1,6

Table C.38. Terrace Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
3	TERRACE	1	43,36

Table C.39. Terrace Roof Projection Area

			AREA
PROJECT	UNIT	pieces	m2
3		1	47,8

Table C.40. Balcony Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
3		1	5,67

Table C.41. Balcony Doors

PROJECT	INFO	PIECES
3		1

Table C.42. Entrance Door

		LENGHT	HEIGHT
PROJECT	pieces	m	m
2	1	1	2,1

APPENDIX D

PROJECT 4 QUANTITY TAKE OFF

Table D.1. Excavation

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
4		1	70,36	0,75	52,8

Table D.2. Fill

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
4		0,6	70,36	0,75	31,7

Table D.3. Blinding Concrete

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
4		1	60,51	0,1	6,1

Table D.4. Blockage

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
4		1	60,51	0,15	9,1

Table D.5. Insulation at ground level

			AREA
PROJECT	UNIT	pieces	m2
4		1	60,51

Table D.6. Concrete

			TOTAL AREA	CONCRETE VOLUME
PROJECT	UNIT	pieces	m2	m3
4		1	144,62	55,0

Table D.7. Reinforcement

			TOTAL AREA	REINFORCEMENT AMOUNT
PROJECT	UNIT	pieces	m2	tons
4		1	144,62	4,9

Table D.8. Formwork

			TOTAL AREA	FORMWORK AREA
PROJECT	UNIT	pieces	m2	m2
4		1	144,62	376,0
			TWICE USAGE	188
		Slab Formwork	1	74
		Other Formwork	1	114

Table D.9. Slab Formwork Scaffolding

		HEIGHT	AREA	VOLUME
		m	m2	m3
Slab Formwork Scaffolding		2,68	74	198,32

Table D.10. Scaffolding for wall plastering

		HEIGHT	LENGTH	AREA
		m	m	m2
Scaffolding for Plastering		6,1	35,8	218,38

Table D.11. Entrance floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
4	B12	1	3,45	2,68	9,2	0,25	2,31
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1AB	1	5,8	2,68	15,5	0,25	3,89
	A12	1	3,52	2,68	9,4	0,25	2,36
	VOID WINDOW	-2	0,6	1,6	-1,9	0,25	-0,48
	VOID WINDOW	-1	1,4	1,6	-2,2	0,25	-0,56
	A23	1	2,5	2,68	6,7	0,25	1,68
	VOID DOOR	-1	1	2,1	-2,1	0,25	-0,53
	VOID WINDOW	-1	0,6	1,3	-0,8	0,25	-0,20
	A34	1	3,32	2,68	8,9	0,25	2,22
	VOID WINDOW	-1	1,4	1,6	-2,2	0,25	-0,56
	VOID WINDOW	-2	0,6	1,6	-1,9	0,25	-0,48

Table D.11 (continued). Entrance floor Outer Walls

4AB	1	5,8	2,68	15,5	0,25	3,89
B34	1	3,05	2,68	8,2	0,25	2,04
VOID WINDOW	-2	0,6	0,6	-0,7	0,25	-0,18
B23	1	2,77	2,68	7,4	0,25	1,86
VOID WINDOW	-1	0,6	1,3	-0,8	0,25	-0,20
TOTAL				66,6		16,64

Table D.12. 1st floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
4	B12	1	3,45	2,68	9,2	0,25	2,31
	VOID WINDOW	-1	1,3	1,3	-1,7	0,25	-0,42
	1AB	1	5,8	2,68	15,5	0,25	3,89
	A12	1	3,52	2,68	9,4	0,25	2,36
	VOID WINDOW	-2	0,6	1,6	-1,9	0,25	-0,48
	VOID WINDOW	-1	1,4	1,6	-2,2	0,25	-0,56
	A23	1	2,5	2,68	6,7	0,25	1,68
	VOID DOOR	-1	1	2,1	-2,1	0,25	-0,53
	VOID WINDOW	-1	0,6	1,3	-0,8	0,25	-0,20
	BALCONY	2	0,75	2,68	4,0	0,25	1,01
	A34	1	3,32	2,68	8,9	0,25	2,22
	VOID WINDOW	-1	1,4	1,6	-2,2	0,25	-0,56
	VOID WINDOW	-2	0,6	1,6	-1,9	0,25	-0,48
	4AB	1	5,8	2,68	15,5	0,25	3,89
	B34	1	3,05	2,68	8,2	0,25	2,04
	VOID WINDOW	-2	0,6	0,6	-0,7	0,25	-0,18
	B23	1	2,77	2,68	7,4	0,25	1,86
	VOID WINDOW	-1	0,6	1,3	-0,8	0,25	-0,20
	TOTAL				70,6		17,65

Table D.13. Entrance Floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
4	KITCHEN	1	3,6	2,68	9,6	0,1	0,96
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	2AB	1	5,24	2,68	14,0	0,1	1,40
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	3AB	1	5,24	2,68	14,0	0,1	1,40
	VOID DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	BR 1	1	3,2	2,68	8,6	0,1	0,86
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19

Table D.13. (continued) Entrance Floor Inner Walls

STORAGE	1	2,6	2,68	7,0	0,1	0,70
WC	1	1,8	2,68	4,8	0,1	0,48
VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
TOTAL				46,8		4,68

Table D.14. 1st floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
4	BR 2	1	3,6	2,68	9,6	0,1	0,96
	2AB	1	4,24	2,68	11,4	0,1	1,14
	VOID DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	3AB	1	4,24	2,68	11,4	0,1	1,14
	VOID DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	BR 1	1	3,2	2,68	8,6	0,1	0,86
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 2	1	2,6	2,68	7,0	0,1	0,70
	TOTAL				38,5		3,85

Table D.15. White Wash for Slab

			AREA
INFO	UNIT	pieces	m2
1st FLOOR		1	60,51
ROOF SLAB		1	61,41
TOTAL WHITE WASH AREA			122

Table D.16. Plastering for Outer Walls

			LENGTH	HEIGHT	AREA
PROJECT		pieces	m	m	m2
4	FLOOR 1	1	49,37	3,3	162,9
	VOID WINDOW	-2	0,6	0,6	-0,7
	VOID WINDOW	-1	1,3	1,3	-1,7
	VOID WINDOW	-2	0,6	1,3	-1,6
	VOID WINDOW	-4	0,6	1,6	-3,8
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	1,4	1,6	-2,2
	VOID DOOR	-1	1	2,1	-2,1
	FLOOR 2	1	49,25	2,68	132,0
	VOID WINDOW	-2	0,6	0,6	-0,7
	VOID WINDOW	-1	1,3	1,3	-1,7

Table D.16. (continued) Plastering for Outer Walls

VOID WINDOW	-2	0,6	1,3	-1,6
VOID WINDOW	-4	0,6	1,6	-3,8
VOID WINDOW	-1	1,5	1,5	-2,3
VOID WINDOW	-1	1,4	1,6	-2,2
VOID DOOR	-1	1	2,1	-2,1
TOTAL				266,1

Table D.17. Roof Projection Area & Roof Insulation

			AREA
PROJECT	UNIT	pieces	m2
4		1	93,5

Table D.18. Living Room Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
4		1	14,49

Table D.19. Living Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	LIVING ROOM	1	15,14	2,68	40,58
	VOID WINDOW	-1	0,6	1,6	-0,96
	VOID WINDOW	-2	1,5	1,6	-4,80
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				32,93

Table D.20. Living Room Doors

PROJECT	INFO	PIECES
4	LIVING ROOM	1

Table D.21. Living Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4	LIVING ROOM	2	0,6	1,6
	LIVING ROOM	1	1,5	1,6

Table D.22. Kitchen Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
4		1	9,86

Table D.23. Kitchen Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	KITCHEN	1	12,31	2,68	32,99
	VOID WINDOW	-1	1,3	1,3	-1,69
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				29,41

Table D.24. Kitchen Doors

PROJECT	INFO	PIECES
4	KITCHEN	1

Table D.25. Kitchen Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4	KITCHEN	1	1,3	1,3

Table D.26. Bathroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
4	WC 1	1	4,38
	BATHROOM 1	1	4,56
	BATHROOM 2	1	3,38
	TOTAL		12,32

Table D.27. Bathroom Wall Covering Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	WC 1	1	12,2	2,68	32,70
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-2	0,9	2,1	-3,78
	BATHROOM 1	1	8,8	2,68	23,58
	VOID DOOR	-1	0,9	2,1	-1,89
	VOID WINDOW	-1	0,6	0,6	-0,36
	BATHROOM 2	1	7,8	2,68	20,90
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				68,54

Table D.28. Bathroom Doors

PROJECT	INFO	pieces
4	WC 1	2
	BATHROOM 1	1
	BATHROOM 2	1
	TOTAL	4

Table D.29. Bathroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4	WC 1	1	0,6	0,6
	BATHROOM 1	1	0,6	0,6
	BATHROOM 2	1	0,6	0,6

Table D.30. Bedroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
4	BR 1	1	12,42
	BR 2	1	12,27
	BR 3	1	10,79
	BR 4	1	12,27
	TOTAL		47,75

Table D.31. Bedroom Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	BR 1	1	14,17	2,68	37,98
	VOID WINDOW	-2	0,6	1,6	-1,92
	VOID WINDOW	-1	1,4	1,6	-2,24
	VOID DOOR	-2	0,9	2,1	-3,78
	BR 2	1	14,08	2,68	37,73
	VOID WINDOW	-1	1,3	1,3	-1,69
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 3	1	13,18	2,68	35,32
	VOID WINDOW	-1	1,5	1,6	-2,40
	VOID WINDOW	-2	0,6	1,6	-1,92
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 4	1	14,06	2,68	37,68
	VOID WINDOW	-2	0,6	1,6	-1,92
	VOID WINDOW	-1	1,4	1,6	-2,24
	VOID DOOR	-2	0,9	2,1	-3,78
	TOTAL				123,04

Table D.32. Bedroom Doors

PROJECT	INFO	pieces
4	BR 1	2
	BR 2	1
	BR 3	1
	BR 4	2
	TOTAL	6

Table D.33. Bedroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4	BR 1	2	0,6	1,6
	BR 1	1	1,4	1,6
	BR 2	1	1,3	1,3
	BR 3	1	1,5	1,6
	BR 3	2	0,6	1,6
	BR 4	2	0,6	1,6
	BR 4	1	1,4	1,6

Table D.34. Entrance and Corridors Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
4	FLOOR 1	1	15,98
	FLOOR 2	1	13,48
	TOTAL		29,46

Table D.35. Entrance and Corridors Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	FLOOR 1	1	22,42	2,68	60,09
	VOID DOOR	-3	0,9	2,1	-5,67
	VOID DOOR	-1	1	2,1	-2,10
	VOID WINDOW	-2	0,6	1,3	-1,56
	FLOOR 2	1	15,42	2,68	41,33
	VOID DOOR	-4	0,9	2,1	-7,56
	VOID DOOR	-1	1	2,1	-2,10
	VOID WINDOW	-2	0,6	1,3	-1,56
	TOTAL				80,86

Table D.36. Entrance and Corridors Doors

PROJECT	INFO	pieces
4	FLOOR 1	3
	FLOOR 2	5
	TOTAL	8

Table D.37. Entrance and Corridors Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4	FLOOR 1	2	0,6	1,3
	FLOOR 2	2	0,6	1,3

Table D.38. Storage Room Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
4		1	3,38

Table D.39. Storage Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
4	FLOOR 1	1	7,8	2,68	20,90
	VOID DOOR	-1	0,9	2,1	-1,89
	VOID WINDOW	-1	0,6	0,6	-0,36
	TOTAL				18,65

Table D.40. Storage Room Doors

PROJECT	INFO	pieces
4		1

Table D.41. Storage Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
4		1	0,6	0,6

Table D.42. Balcony Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
4		1	4,66

Table D.43. Balcony Doors

PROJECT	INFO	PIECES
4		1

Table D.44. Entrance Door

		LENGHT	HEIGHT
PROJECT	pieces	m	m
2	1	1	2,1

APPENDIX E

PROJECT 5 QUANTITY TAKE OFF

Table E.1. Excavation

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
5		1	228	0,75	171,0

Table E.2. Fill

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
5		0,6	228	0,75	102,6

Table E.3. Blinding Concrete

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
5		1	209,94	0,1	21,0

Table E.4. Blockage

			AREA	HEIGHT	VOLUME
PROJECT	UNIT	pieces	m2	m	m3
5		1	209,94	0,15	31,5

Table E.5. Insulation at ground level

			AREA
PROJECT	UNIT	pieces	m2
5		1	209,94

Table E.6. Concrete

			TOTAL AREA	CONCRETE VOLUME
PROJECT	UNIT	pieces	m2	m3
5		1	393	149,3

Table E.7. Reinforcement

			TOTAL AREA	REINFORCEMENT AMOUNT
PROJECT	UNIT	pieces	m2	tons
5		1	393	13,4

Table E.8. Formwork

			TOTAL AREA	FORMWORK AREA
PROJECT	UNIT	pieces	m2	m2
5		1	393	1021,8
			TWICE USAGE	511
		Slab Formwork	1	159
		Other Formwork	1	352

Table E.9. Slab Formwork Scaffolding

		HEIGHT	AREA	VOLUME
		m	m2	m3
Slab Formwork Scaffolding		3,08	159	489,72

Table E.10. Scaffolding for wall plastering

		HEIGHT	LENGTH	AREA
		m	m	m2
Scaffolding for Plastering		6,5	58	377,00

Table E.11. Entrance floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
5	1DG	1	4,75	3,08	14,6	0,25	3,66
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	1DA	1	3,35	3,08	10,3	0,25	2,58
	A13	1	3,9	3,08	12,0	0,25	3,00
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	B34	1	2,8	3,08	8,6	0,25	2,16
	B45	1	2,8	0,7	2,0	0,25	0,49
	VOID DOOR	-1	1,1	2,1	-2,3	0,25	-0,58
	B67	1	2,8	3,08	8,6	0,25	2,16
	VOID WINDOW	-1	0,5	0,5	-0,3	0,25	-0,06
	A79	1	3,9	3,08	12,0	0,25	3,00
	VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56

Table E.11 (continued). Entrance floor Outer Walls

9AD	1	3,35	3,08	10,3	0,25	2,58
9DG	1	4,75	3,08	14,6	0,25	3,66
VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
4CE	1	2,3	3,08	7,1	0,25	1,77
VOID DOOR	-2	0,8	2,1	-3,4	0,25	-0,84
G89	1	3,5	3,08	10,8	0,25	2,70
VOID WINDOW	-1	1	2,1	-2,1	0,25	-0,53
VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
F67	1	3,25	3,08	10,0	0,25	2,50
VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
F45	1	2,3	3,08	7,1	0,25	1,77
F24	1	3,15	3,08	9,7	0,25	2,43
VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
F12	1	3,5	3,08	10,8	0,25	2,70
VOID WINDOW	-1	0,9	2,2	-2,0	0,25	-0,50
TOTAL				122,3		30,57

Table E.12. 1st floor Outer Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
5	1DG	1	4,75	2,78	13,2	0,25	3,30
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	VOID WINDOW	-1	0,5	0,5	-0,3	0,25	-0,06
	1DA	1	3,35	2,78	9,3	0,25	2,33
	A13	1	3,9	2,78	10,8	0,25	2,71
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	A34	1	3,13	2,78	8,7	0,25	2,18
	VOID WINDOW	-2	0,4	0,9	-0,7	0,25	-0,18
	B45	1	2,8	0,7	2,0	0,25	0,49
	4AB	1	0,65	2,78	1,8	0,25	0,45
	6AB	1	0,65	2,78	1,8	0,25	0,45
	A67	1	3,13	2,78	8,7	0,25	2,18
	VOID WINDOW	-2	0,4	0,9	-0,7	0,25	-0,18
	A79	1	3,9	2,78	10,8	0,25	2,71
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	9AD	1	3,35	2,78	9,3	0,25	2,33
	9DG	1	4,75	2,78	13,2	0,25	3,30
	VOID WINDOW	-1	0,5	0,5	-0,3	0,25	-0,06
	VOID WINDOW	-1	1,5	1,7	-2,6	0,25	-0,64
	G89	1	3,5	2,78	9,7	0,25	2,43
	F67	1	3,25	2,78	9,0	0,25	2,26
	VOID WINDOW	-1	1,5	1,5	-2,3	0,25	-0,56
	F45	1	2,3	2,78	6,4	0,25	1,60

Table E.12. (continued) 1st floor Outer Walls

F24	1	3,15	2,78	8,8	0,25	2,19
VOID WINDOW	-1	0,6	0,6	-0,4	0,25	-0,09
VOID DOOR	-1	0,9	2,1	-1,9	0,25	-0,47
F12	1	3,5	2,78	9,7	0,25	2,43
TOTAL				116,7		29,18

Table E.13. Entrance Floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
5	4EF	1	2,8	3,08	8,6	0,1	0,86
	5EF	1	2,8	3,08	8,6	0,1	0,86
	E67	1	3,1	3,08	9,5	0,1	0,95
	7EC	1	2,4	3,08	7,4	0,1	0,74
	VIOD DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	D79	1	3,9	3,08	12,0	0,1	1,20
	VIOD DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	C67	1	2,95	3,08	9,1	0,1	0,91
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	WC	1	1,2	3,08	3,7	0,1	0,37
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	TOTAL				51,4		5,14

Table E.14. 1st floor Inner Walls

			LENGTH	HEIGHT	AREA	WIDTH	VOLUME
PROJECT	INFO	pieces	m	m	m2	m	m3
5	4EF	1	2,8	2,78	7,8	0,1	0,78
	5EF	1	2,8	2,78	7,8	0,1	0,78
	E67	1	3,1	2,78	8,6	0,1	0,86
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	8EF	1	3,05	2,78	8,5	0,1	0,85
	E89	1	3,5	2,78	9,7	0,1	0,97
	VOID DOOR	-2	0,9	2,1	-3,8	0,1	-0,38
	D69	1	5,95	2,78	16,5	0,1	1,65
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	BATHROOM 3	2	1,1	2,78	6,1	0,1	0,61
	7BD	1	2,4	2,78	6,7	0,1	0,67
	6DC	1	1,2	2,78	3,3	0,1	0,33
	VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
	4DC	1	1,2	2,78	3,3	0,1	0,33
	D34	1	2,8	2,78	7,8	0,1	0,78
	3DE	1	1,25	2,78	3,5	0,1	0,35

Table E.14. (continued) 1st floor Inner Walls

VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
BR 1	1	5,3	2,78	14,7	0,1	1,47
VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
BR 1	1	3,05	2,78	8,5	0,1	0,85
BATHROOM 2	2	1,25	2,78	7,0	0,1	0,70
BR 2	1	1,45	2,78	4,0	0,1	0,40
VOID DOOR	-1	0,9	2,1	-1,9	0,1	-0,19
TOTAL				108,7		10,87

Table E.15. White Wash for Slab

			AREA
INFO	UNIT	pieces	m2
1st FLOOR		1	140,94
ROOF SLAB		1	145,74
TOTAL WHITE WASH AREA			287

Table E.16. Plastering for Outer Walls

			LENGTH	HEIGHT	AREA
PROJECT		pieces	m	m	m2
5	FLOOR 1	1	58	3,6	208,8
	VOID WINDOW	-1	0,5	0,5	-0,3
	VOID WINDOW	-3	1,5	1,5	-6,8
	VOID WINDOW	-3	1,5	1,7	-7,7
	VOID WINDOW	-1	1	2,1	-2,1
	VOID WINDOW	-1	0,9	2,2	-2,0
	VOID DOOR	-1	1,1	2,1	-2,3
	VOID DOOR	-1	0,9	2,1	-1,9
	FLOOR 2	1	57,8	2,9	167,6
	VOID WINDOW	-4	0,4	0,9	-1,4
	VOID WINDOW	-4	1,5	1,7	-10,2
	VOID WINDOW	-2	0,5	0,5	-0,5
	VOID WINDOW	-1	1,5	1,5	-2,3
	VOID WINDOW	-1	0,6	0,6	-0,4
	VOID DOOR	-1	0,9	2,1	-1,9
	TOTAL				336,9

Table E.17. Roof Projection Area & Roof Insulation

			AREA
PROJECT	UNIT	pieces	m2
5		1	213,1

Table E.18. Living Room Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
5		1	75,08

Table E.19. Living Room Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
5	LIVING ROOM	1	32	3,08	98,56
	VOID WINDOW	-2	1,5	1,7	-5,10
	VOID WINDOW	-1	1,5	1,5	-2,25
	VOID WINDOW	-1	0,9	2,2	-1,98
	VOID DOOR	-2	0,8	2,1	-3,36
	DINING ROOM	1	17,8	3,08	54,82
	VOID WINDOW	-1	1,5	1,7	-2,55
	VOID WINDOW	-1	1	2,1	-2,10
	VOID DOOR	-3	0,9	2,1	-5,67
	TOTAL				130,37

Table E.20. Living Room Doors

PROJECT	INFO	PIECES
5	LIVING ROOM	2
	DINING ROOM	3
	TOTAL	5

Table E.21. Living Room Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
5	LIVING ROOM	2	1,5	1,7
	LIVING ROOM	1	1,5	1,5
	LIVING ROOM	1	0,9	2,2
	DINING ROOM	1	1,5	1,7
	DINING ROOM	1	1	2,1

Table E.22. Kitchen Floor Covering Area

			AREA
PROJECT	UNIT	pieces	m2
5		1	12,23

Table E.23. Kitchen Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
5	KITCHEN	1	11,2	3,08	34,50
	VOID WINDOW	-1	1,5	1,5	-2,25
	TOTAL				32,25

Table E.24. Kitchen Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
5	KITCHEN	1	1,5	1,5

Table E.25. Bathroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
5	BATHROOM 1	1	11,21
	BATHROOM 2	1	1,69
	BATHROOM 3	1	1,39
	WC	1	2,94
	TOTAL		17,23

Table E.26. Bathroom Wall Covering Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
5	BATHROOM 1	1	13,22	2,78	36,75
	VOID WINDOW	-2	0,4	0,9	-0,72
	VOID DOOR	-1	0,9	2,1	-1,89
	WC	1	7,3	3,08	22,48
	VOID WINDOW	-1	0,5	0,5	-0,25
	VOID DOOR	-1	0,9	2,1	-1,89
	BATHROOM 2	1	5,2	2,78	14,46
	VOID WINDOW	-1	0,5	0,5	-0,25
	VOID DOOR	-1	0,9	2,1	-1,89

Table E.26. (continued) Bathroom Wall Covering Area

BATHROOM 3	1	4,8	2,78	13,34
VOID WINDOW	-1	0,5	0,5	-0,25
VOID DOOR	-1	0,9	2,1	-1,89
TOTAL				78,01

Table E.27. Bathroom Doors

PROJECT	INFO	pieces
5	BATHROOM 1	1
	WC 1	1
	BATHROOM 2	1
	BATHROOM 3	1
	TOTAL	4

Table E.28. Bathroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
5	BATHROOM 1	2	0,4	0,9
	WC	1	0,5	0,5
	BATHROOM 2	1	0,5	0,5
	BATHROOM 3	1	0,5	0,5

Table E.29. Bedroom Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
5	BR 1	1	20,2
	BR 2	1	27,24
	BR 3	1	11,9
	BR 4	1	15,3
	BR 5	1	13,86
	ROOM 1	1	13,86
	TOTAL		102,36

Table E.30. Bedroom Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
5	BR 1	1	20,2	2,78	56,16
	VOID WINDOW	-1	1,5	1,7	-2,55
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 2	1	27,24	2,78	75,73
	VOID WINDOW	-1	1,5	1,7	-2,55
	VOID WINDOW	-2	0,4	0,9	-0,72
	VOID DOOR	-2	0,9	2,1	-3,78
	BR 3	1	11,9	2,78	33,08
	VOID WINDOW	-1	1,5	1,5	-2,25
	VOID DOOR	-1	0,9	2,1	-1,89
	BR 4	1	15,3	2,78	42,53
	VOID WINDOW	-1	1,5	1,7	-2,55
	VOID DOOR	-2	0,9	2,1	-3,78
	BR 5	1	13,86	2,78	38,53
	VOID WINDOW	-1	1,5	1,7	-2,55
	VOID DOOR	-1	0,9	2,1	-1,89
	ROOM 1	1	15,6	3,08	48,05
	VOID WINDOW	-1	1,5	1,5	-2,25
	VOID DOOR	-1	0,9	2,1	-1,89
	TOTAL				263,54

Table E.31. Bedroom Doors

PROJECT	INFO	pieces
5	BR 1	1
	BR 2	2
	BR 3	1
	BR 4	2
	BR 5	1
	ROOM 1	1
	TOTAL	8

Table E.32. Bedroom Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
5	BR 1	1	1,5	1,7
	BR 2	1	1,5	1,7
	BR 2	2	0,4	0,9
	BR 3	1	1,5	1,5

Table E.32. (continued) Bedroom Windows

BR 4	1	1,5	1,7
BR 5	1	1,5	1,7
ROOM 1	1	1,5	1,5

Table E.33. Entrance and Corridors Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
5	FLOOR 1	1	25,7
	FLOOR 2	1	33,25
	TOTAL		58,95

Table E.34. Entrance and Corridors Wall Paint Area

			LENGTH	HEIGHT	AREA
PROJECT	INFO	pieces	m	m	m2
5	FLOOR 1	1	25,8	3,08	79,46
	VOID DOOR	-2	0,8	2,1	-3,36
	VOID DOOR	-1	1,1	2,1	-2,31
	VOID DOOR	-2	0,9	2,1	-3,78
	FLOOR 2	1	44,1	2,78	122,60
	VOID WINDOW	-1	0,6	0,6	-0,36
	VOID DOOR	-7	0,9	2,1	-13,23
	TOTAL				179,02

Table E.35. Entrance and Corridors Doors

PROJECT	INFO	pieces
5	FLOOR 1	4
	FLOOR 2	7
	TOTAL	11

Table E.36. Entrance and Corridors Windows

			LENGTH	HEIGHT
PROJECT	INFO	PIECES	m	m
5	FLOOR 2	1	0,6	0,6

Table E.37. Terrace Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
5	BACK TERRACE	1	68,96
	TOTAL	1	68,96

Table E.38. Terrace Roof Projection Area

			AREA
PROJECT	UNIT	pieces	m2
5	BACK TERRACE	1	63,6

Table E.39. Terrace Doors

PROJECT	INFO	PIECES
5	BACK TERRACE	1

Table E.40. Balcony Floor Covering Area

			AREA
PROJECT	INFO	pieces	m2
5	BALCONY	1	9,7
	FRONT TERRACE	1	11,13
	TOTAL		20,83

Table E.41. Balcony Doors

PROJECT	INFO	PIECES
5	BALCONY	1

Table E.42. Entrance Door

		LENGHT	HEIGHT
PROJECT	pieces	m	m
5	1	1,1	2,1

APPENDIX F

COST CALCULATIONS OF BATHROOM FAUCETS

Table F.1. Cost calculations for bathroom faucets: Project 1

ROOMS		***COST ITEMS FOR BATHROOMS (YTL)***				
		SHOWER BATH	***BATH TUB***	***WASHBASIN***	***WATER CLOSET***	***TOTAL***
BATHROOM 1	MIN	560	0	53	175	788
	MAX	680	0	120	320	1120
WC 1	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
BATHROOM 2	MIN	560	0	53	175	788
	MAX	680	0	120	320	1120
BATHROOM 3	MIN	560	0	53	175	788
	MAX	680	0	120	320	1120
BATHROOM 4	MIN	560	0	53	175	788
	MAX	680	0	120	320	1120
TOTAL COST OF BATHROOM FAUCETS: PROJECT 1					***MIN***	***3380***
					MAX	***4920***

Table F.2. Cost calculations for bathroom faucets: Project 2

ROOMS		***COST ITEMS FOR BATHROOMS (YTL)***				
		SHOWER BATH	***BATH TUB***	***WASHBASIN***	***WATER CLOSET***	***TOTAL***
BATHROOM 1	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
WC 1	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
BATHROOM 2	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
WC 2	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
TOTAL COST OF BATHROOM FAUCETS: PROJECT 2					***MIN***	***2166***
					MAX	***3220***

Table F.3. Cost calculations for bathroom faucets: Project 3

ROOMS		***COST ITEMS FOR BATHROOMS (YTL)***				
		SHOWER BATH	***BATH TUB***	***WASHBASIN***	***WATER CLOSET***	***TOTAL***
BATHROOM 1	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
WC 1	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
BATHROOM 2	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
BATHROOM 3	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
TOTAL COST OF BATHROOM FAUCETS: PROJECT 3					***MIN***	***2793***
					MAX	***3950***

Table F.4. Cost calculations for bathroom faucets: Project 4

ROOMS		***COST ITEMS FOR BATHROOMS (YTL)***				
		SHOWER BATH	***BATH TUB***	***WASHBASIN***	***WATER CLOSET***	***TOTAL***
BATHROOM 1	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
WC 1	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
BATHROOM 2	MIN	560	0	120	175	855
	MAX	680	0	170	320	1170
TOTAL COST OF BATHROOM FAUCETS: PROJECT 4					***MIN***	***1938***
					MAX	***2780***

Table F.5. Cost calculations for bathroom faucets: Project 5

ROOMS		***COST ITEMS FOR BATHROOMS (YTL)***				
		SHOWER BATH	***BATH TUB***	***WASHBASIN***	***WATER CLOSET***	***TOTAL***
BATHROOM 1	MIN	560	690	120	175	1545
	MAX	680	1720	170	320	2890
WC 1	MIN	0	0	53	175	228
	MAX	0	0	120	320	440
BATHROOM 2	MIN	560	0	120	0	680
	MAX	680	0	170	0	850
BATHROOM 3	MIN	560	0	120	0	680
	MAX	680	0	170	0	850
TOTAL COST OF BATHROOM FAUCETS: PROJECT 5					***MIN***	***3133***
					MAX	***5030***

APPENDIX G

PROJECT DRAWINGS

Figure G.1. Project 1: Front View

Figure G.2. Project 1: Side View

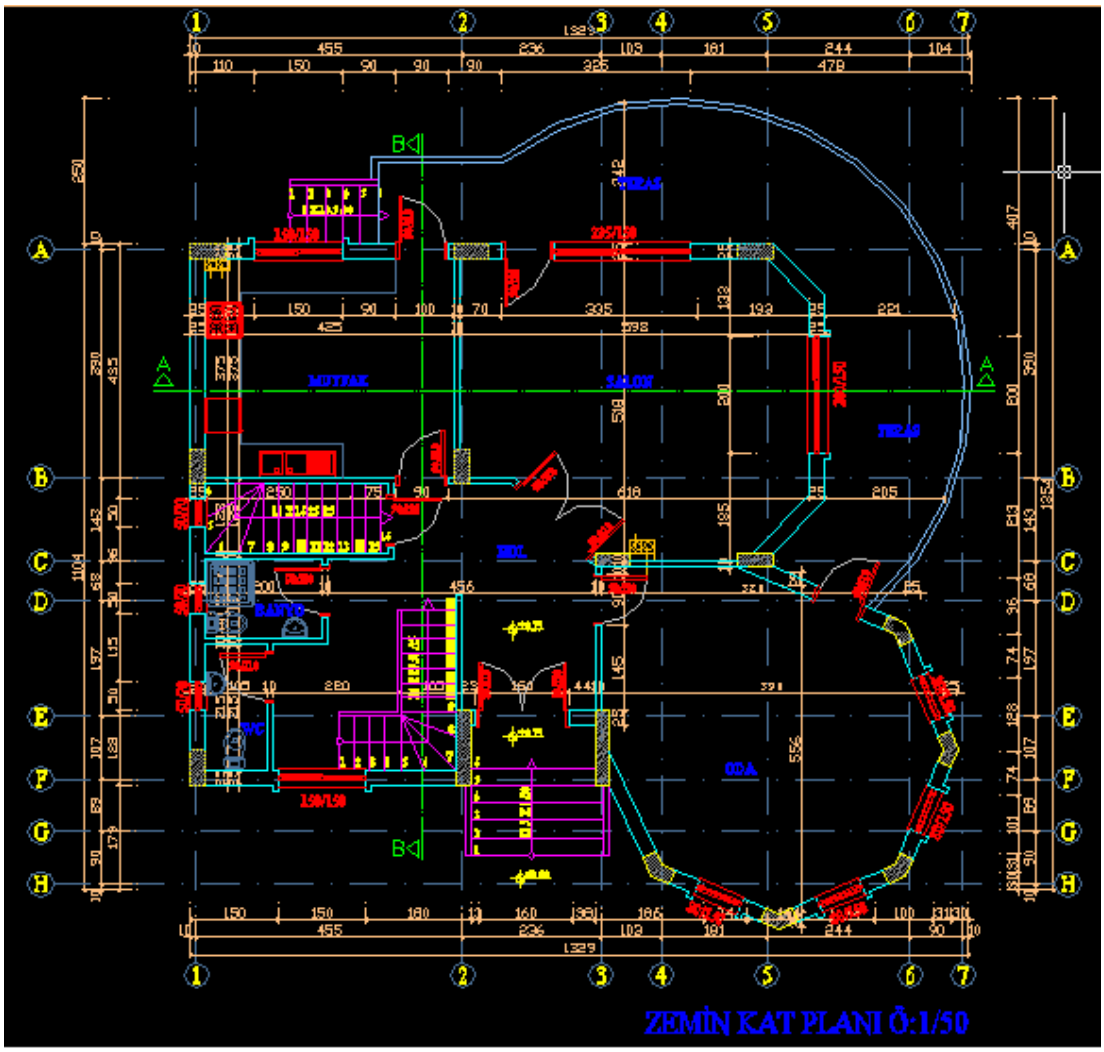

Figure G.3. Project 1: Entrance Floor Plan

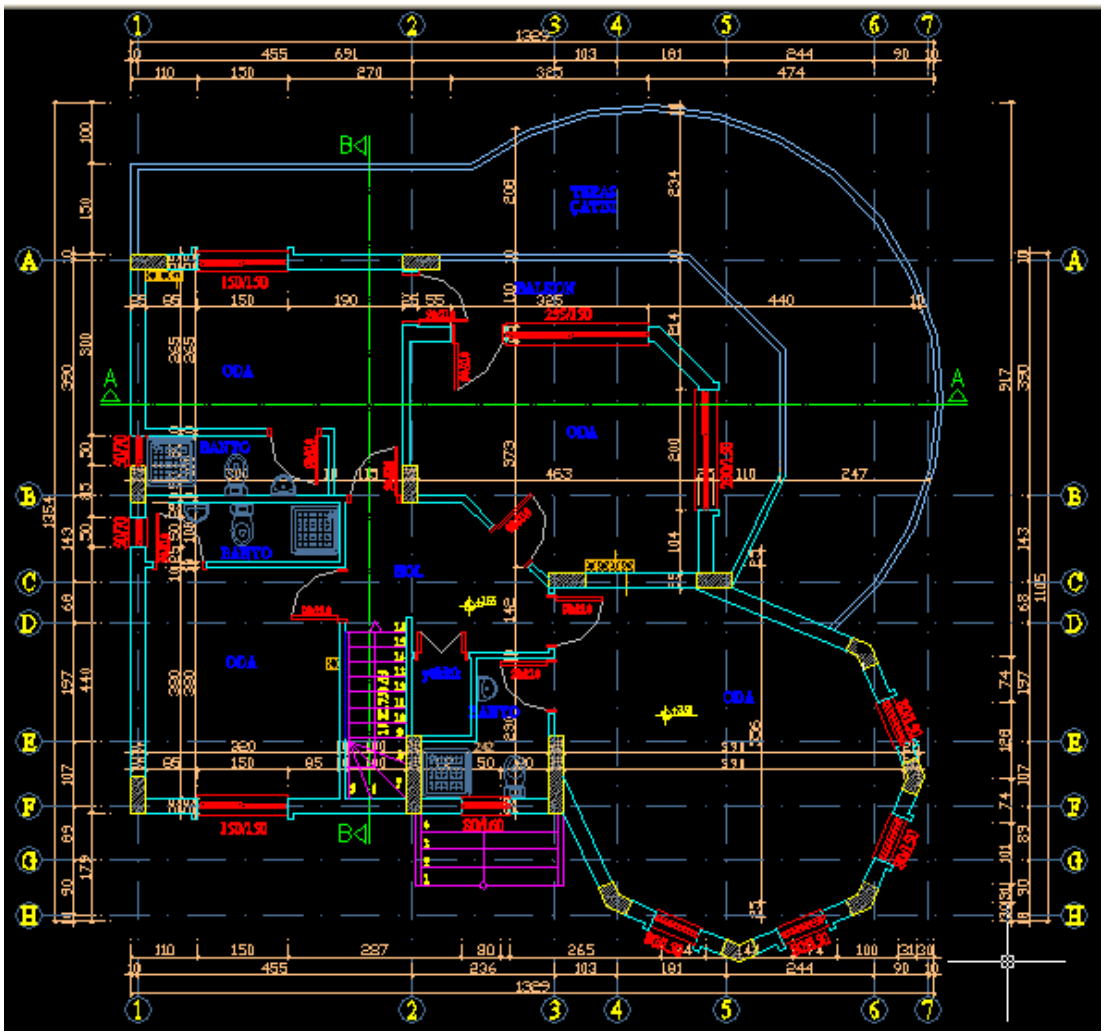

Figure G.4. Project 1: 1st Floor Plan

Figure G.5. Project 2: Front View

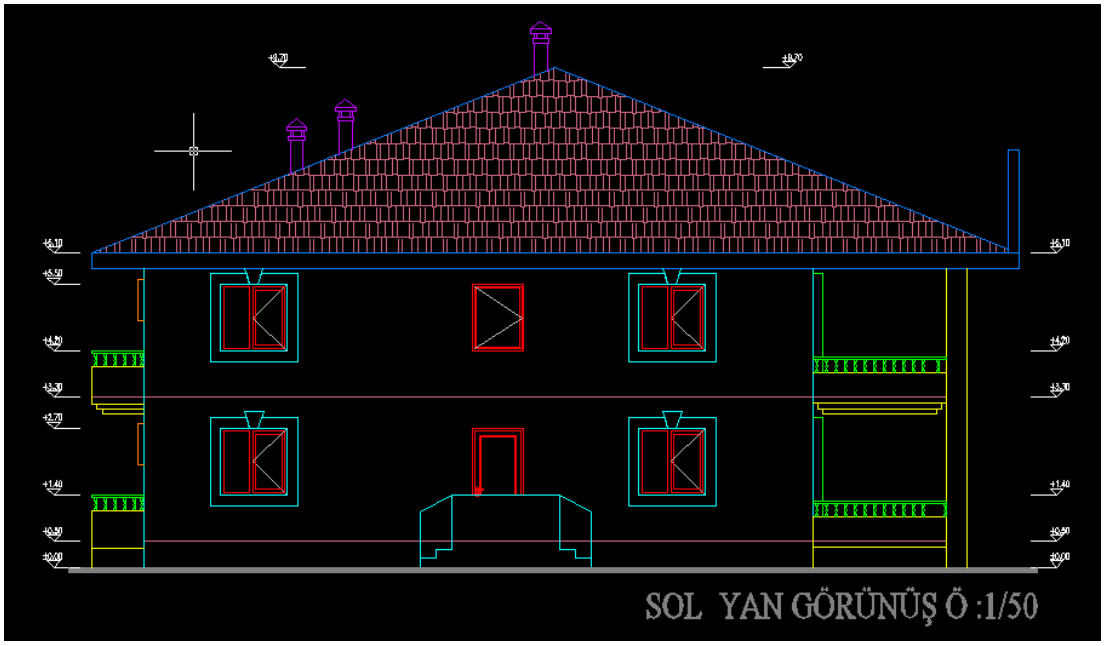

Figure G.6. Project 2: Side View

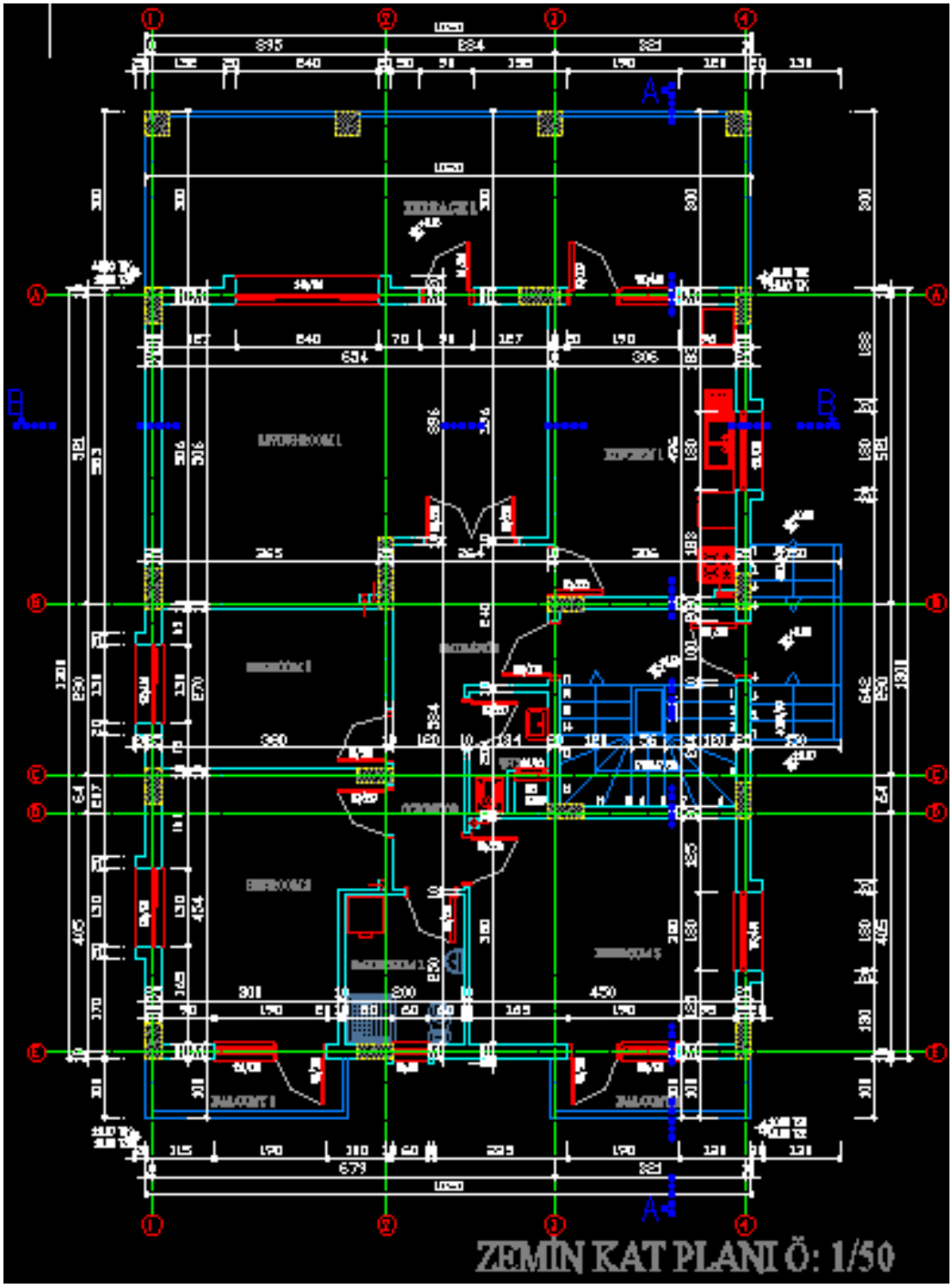

Figure G.7. Project 2: Entrance Floor Plan

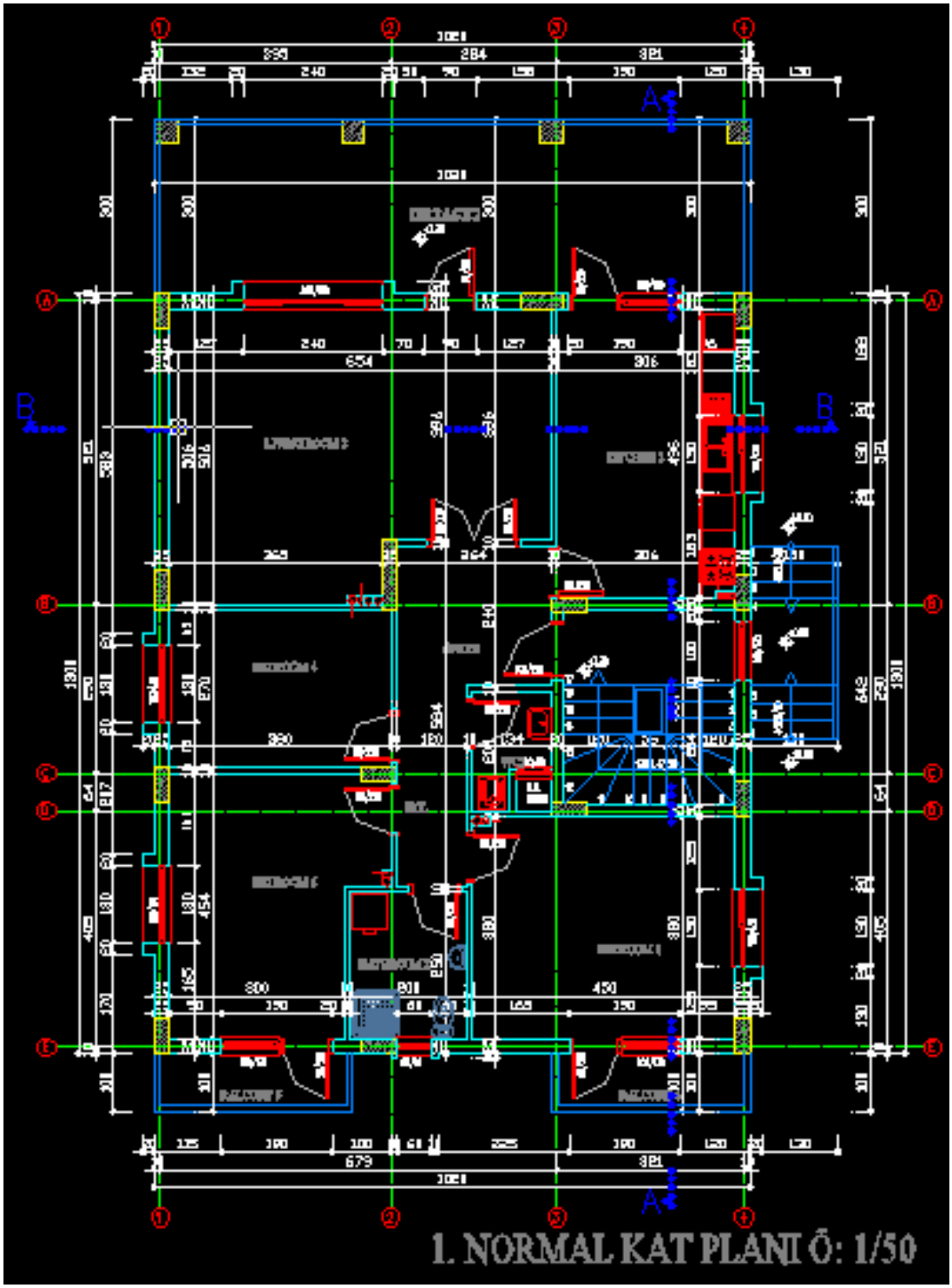

Figure G.8. Project 2: 1st Floor Plan

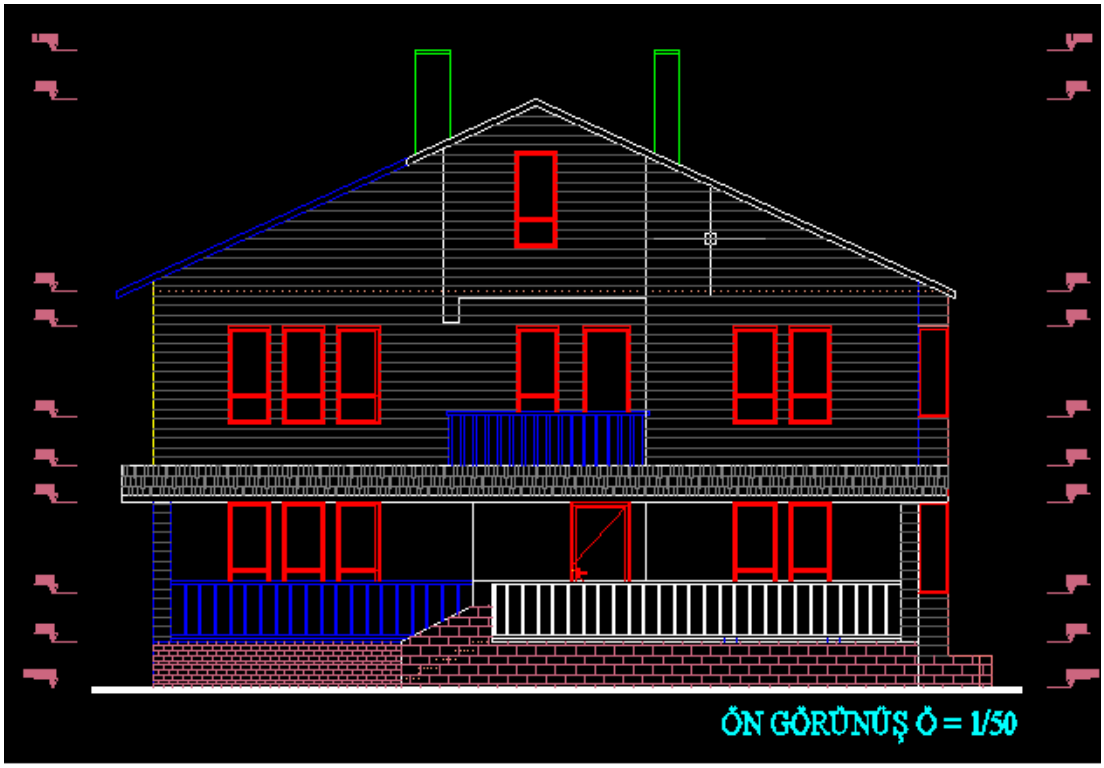

Figure G.9. Project 3: Front View

Figure G.10. Project 3: Side View

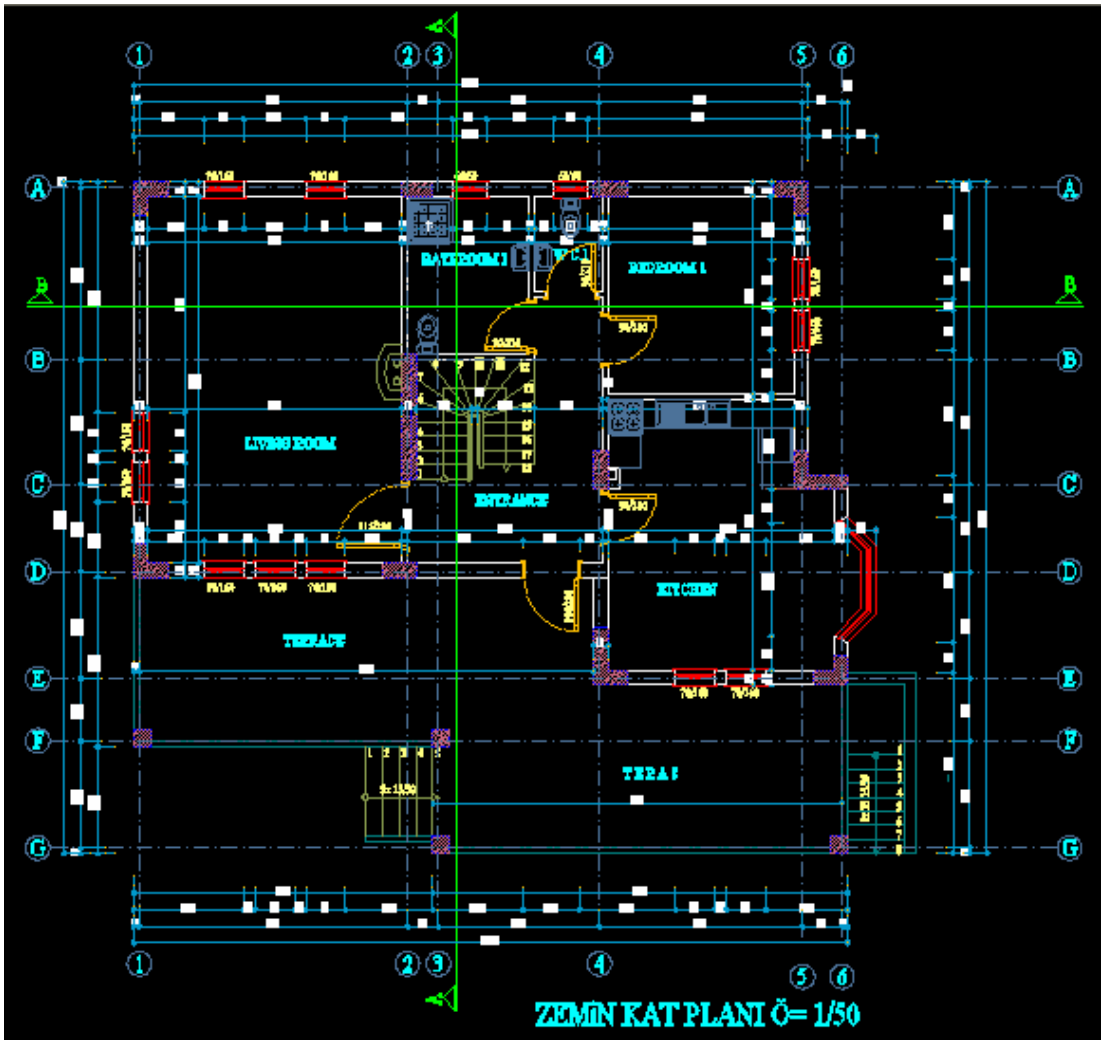

Figure G.11. Project 3: Entrance Floor Plan

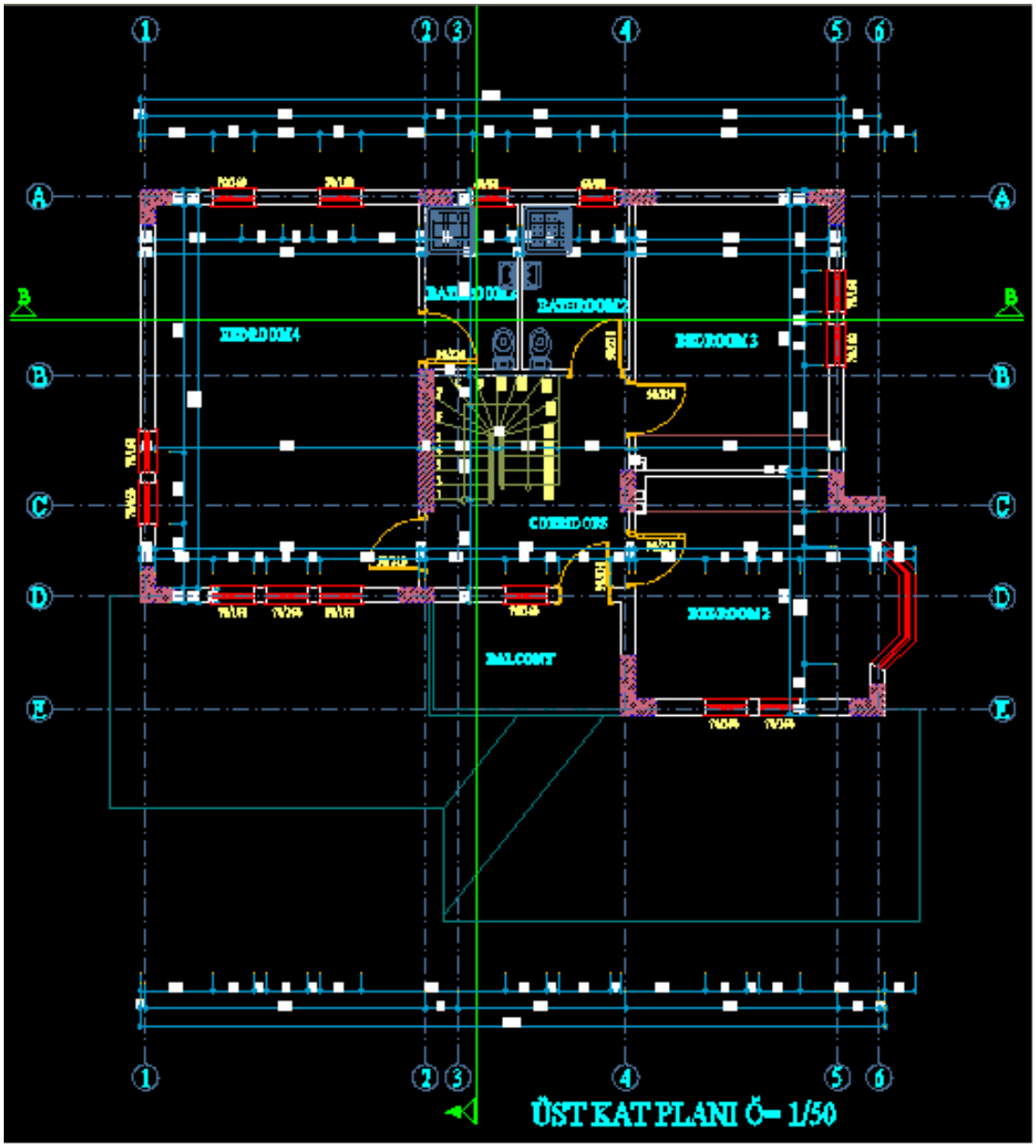

Figure G.12. Project 3: 1st Floor Plan

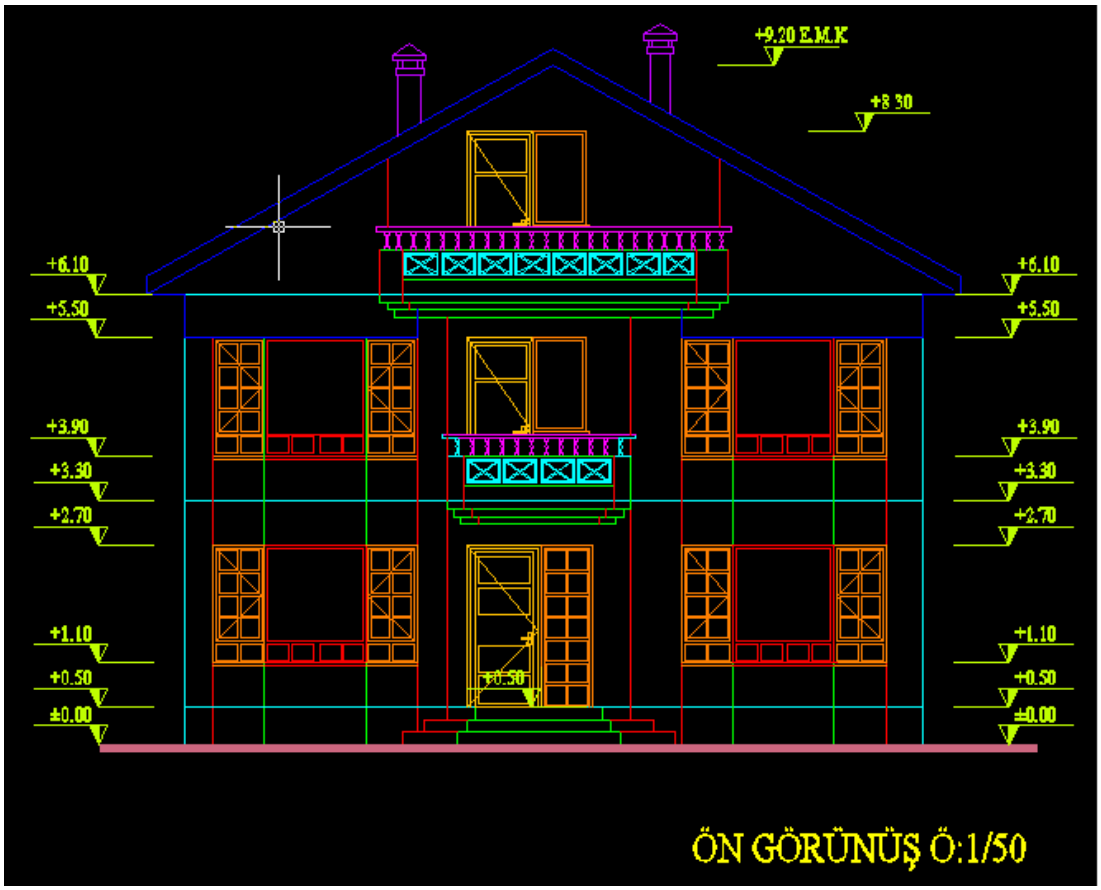

Figure G.13. Project 4: Front View

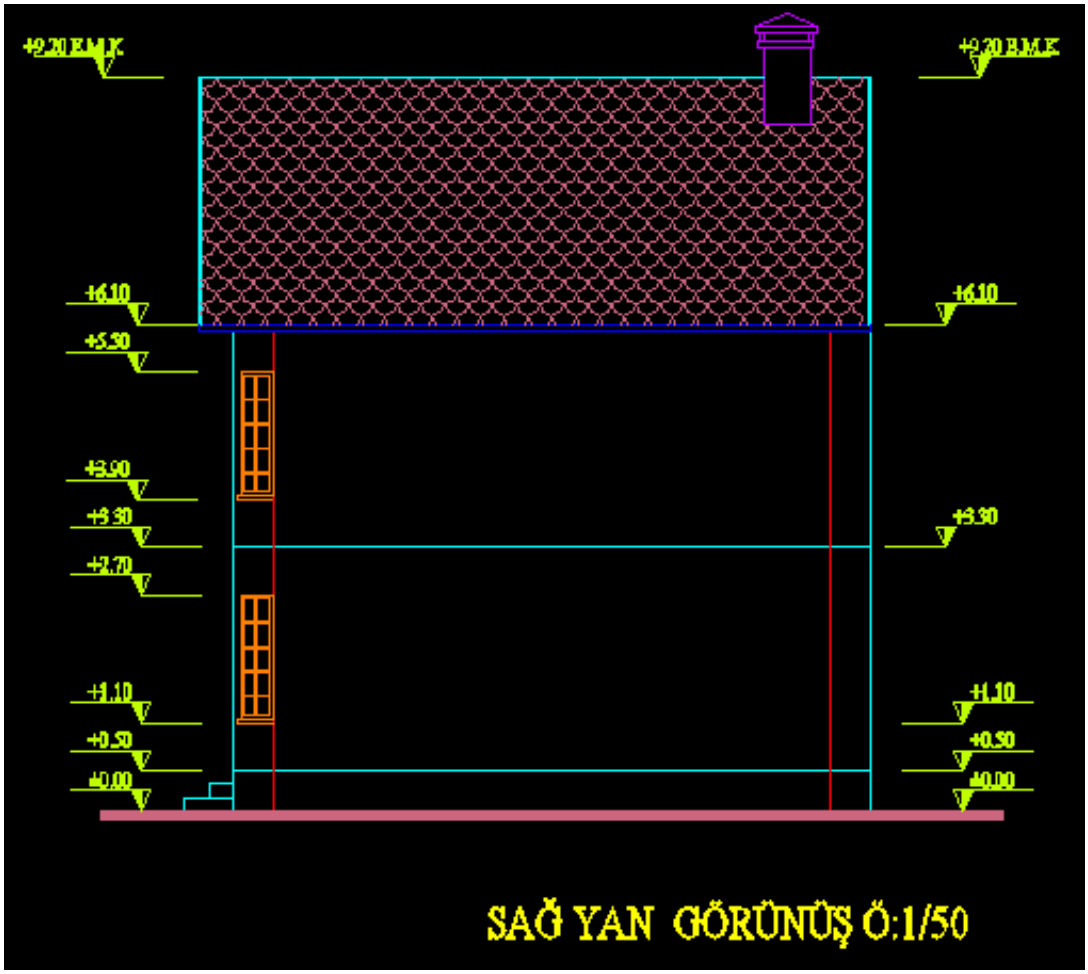

Figure G.14. Project 4: Side View

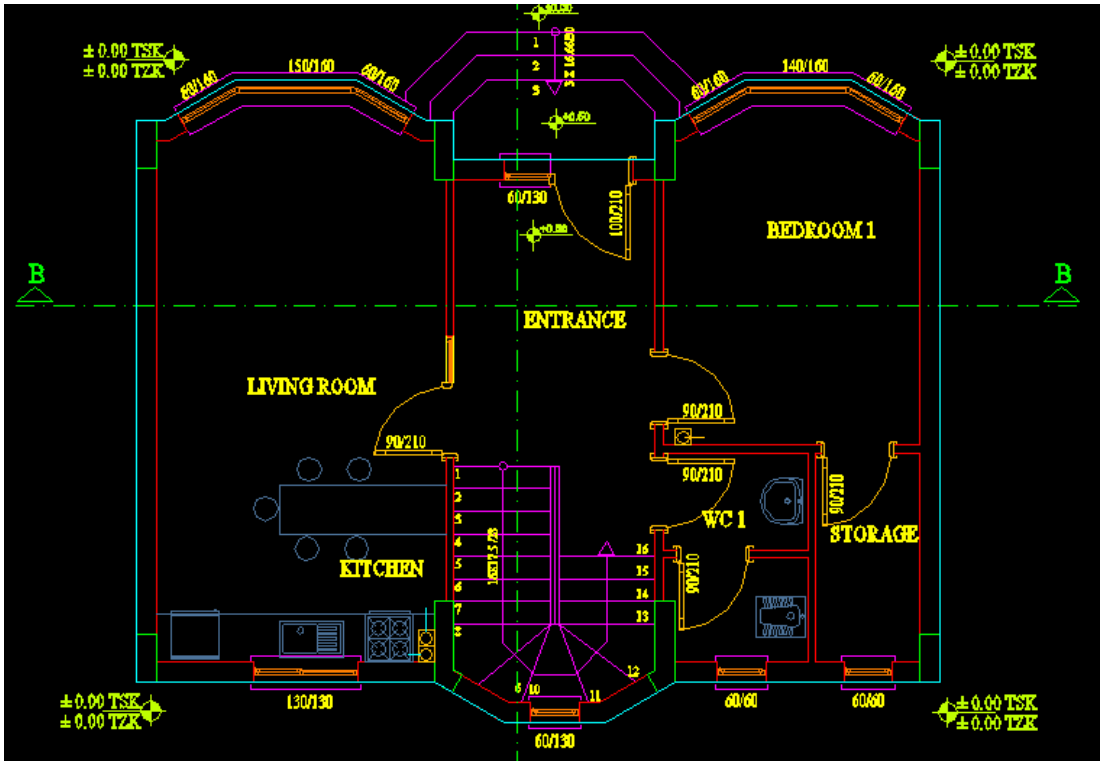

Figure G.15. Project 4: Entrance Floor Plan

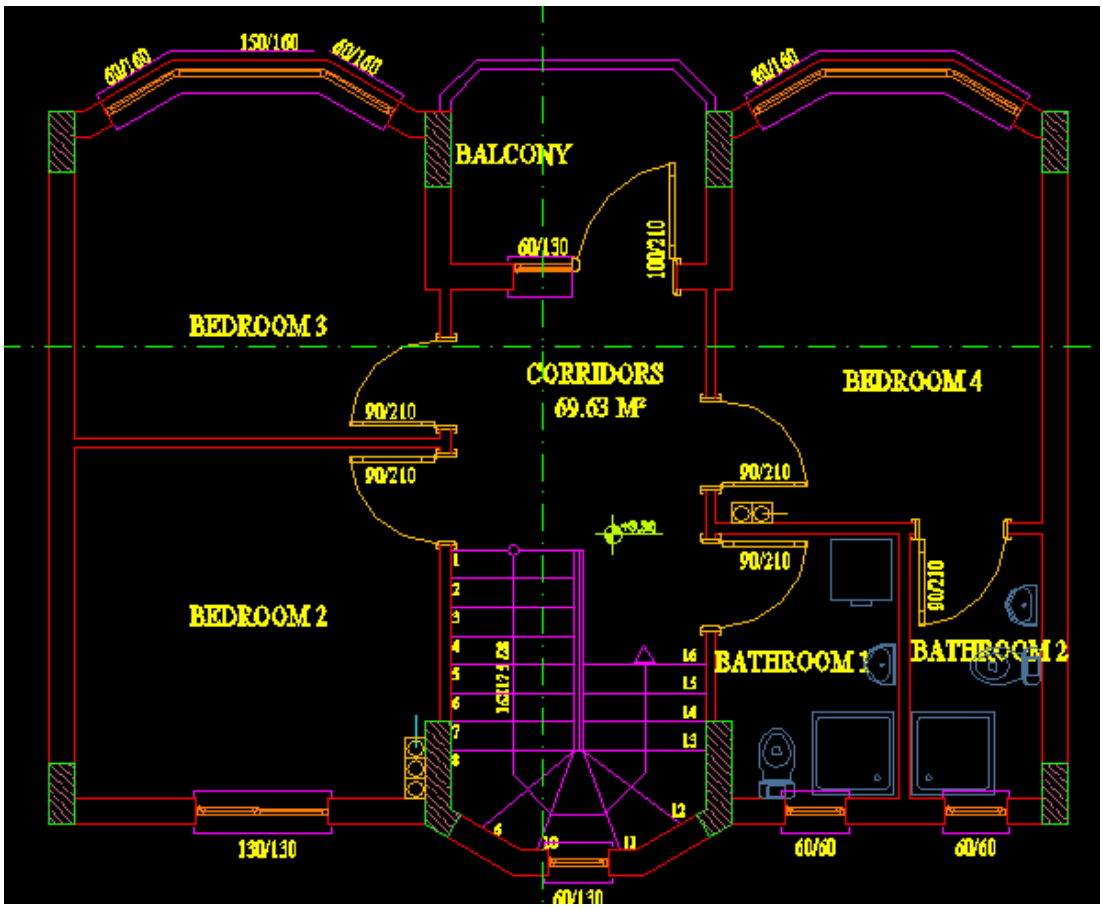

Figure G.16. Project 4: 1st Floor Plan

Figure G.17. Project 5: Front View

Figure G.18. Project 5: Side View

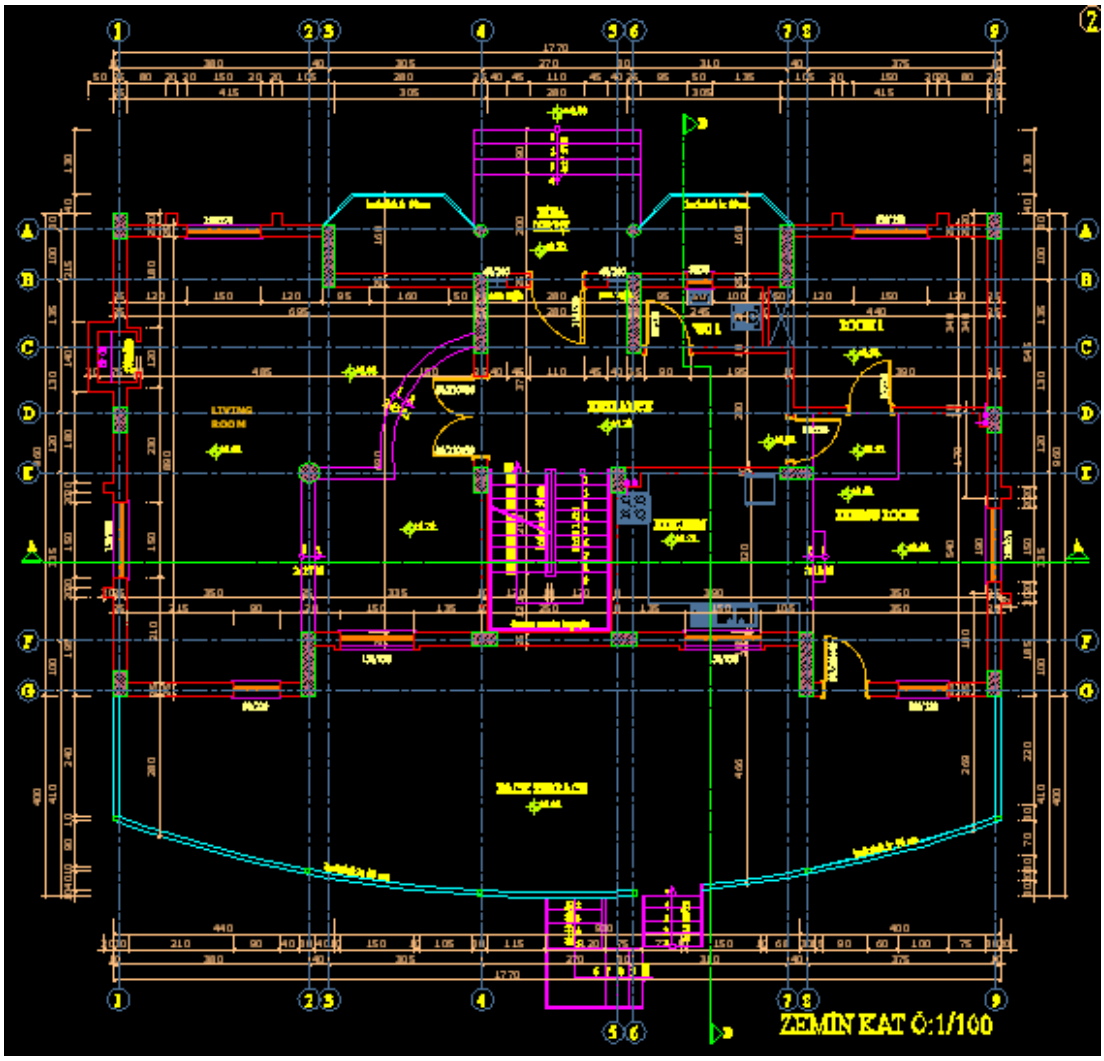

Figure G.19. Project 5: Entrance Floor Plan

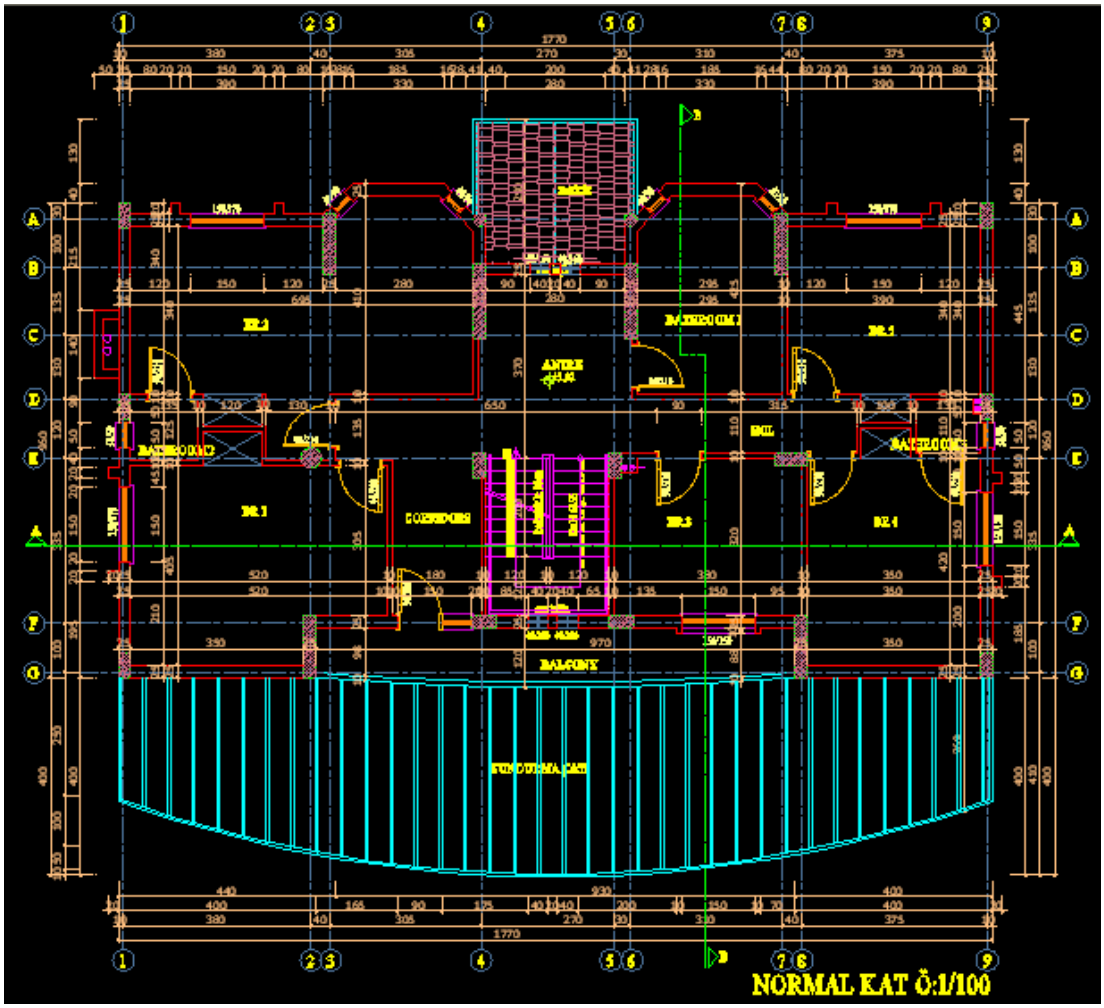

Figure G.20. Project 5: 1st Floor Plan