MSc Program
Wood Based Building Design for Sustainable Urban Development

POTENTIAL ANALYZE OF CONSTRUCTING MID-RISE CONTEMPORARY WOOD BASED BUILDINGS IN TURKEY, URBAN EXAMPLE; ISTANBUL

A Master Thesis submitted for the degree of
“Master of Science”

supervised by
PROF. DDI WOLFGANG WINTER

Arch. BUGRA CETECI
0628065

VIENNA / SEPTEMBER 2008

I PREFACE

I am an architect… After my 4,5 years intensive design based education in Istanbul, I wanted to be specialized in one topic that I can go further with my career besides architecture. For being a full equipped professional you have to know what is going on behind the scene. In architecture you can be open-minded and free as you wish but when it comes to reality you have to think rational and understand how to stand on foot.

With the technology and engineering of today, almost everything is possible, at least conceivable. Scientists are designing an elevator to the space or trying to find the secrets of the universe. There is no limit anymore or in another words, limits are flexible. With timber it is the same. The material of yesterday has changed, engineered, developed and it became the material of today. In Turkey this realization is still missing and my point is to bring that forward. For this purpose I decided to come to Austria and gain experience, knowledge about timber constructions. And this master program has improved my vision.

Fulfilling that wishes wouldn't be possible without external input, support and consulting from involved people. This results in my sincere appreciation to:

- Academic Director of that MSc Program and my supervisor Prof. DDI Wolfgang Winter from Vienna University of Technology, Vice-Academic Director Prof. DI Peer Haller from Dresden University of Technology, Vice-Academic Director Prof. Clara Bertolini Cestari from Politecnico di Torino, Program Coordinator Ass.Prof. Yoshiaki Amino from TU Vienna. Their involvement in different fields of structural engineering and architecture has been very inspiring and improving on both, research and knowledge.

- My family, I wouldn't be here studying and writing a work like this without their material aid and spiritual support.

- My Dear fiancé, Regina, for the corrections that she did and the patience she had during the long nights while I was working with my work in our small flat.

II ABSTRACT

The hypothesis *is to find out possibilities in bringing back timber to Turkish construction market. The country has potential for both, industrial and the demand base. In Turkish building construction methods, structural application of timber has been disregarded since a long time. However, the timber industry started to develop in the last decades and has a potential to compete with European standards. This positive progress of timber should continue through more researches and the prefabrication, so contemporary timber structural solutions can be regarded in Turkey again.*

The aim is to lead the attention again to the timber industry and the timber market in order to use the possibilities of 21st centuries' contemporary construction systems with the potential available in Turkey.

This work is trying to push this aim through pointing out the hidden potential of Turkish timber construction.
First of all, old methods and constructions are presented. Based on this, the work continues with a comparison of the industrial capacity and other construction industries as cement and steel industry. To conclude this for the most important affect of demand, cost analyses are done based on a case study project in Istanbul. These analyses show the economical relations between a concrete building and a timber building. Further more two cases state the effects on costs if the production would be done in Turkey instead of importing timber.

Keywords, Timber construction in Turkey, Construction Industry in Turkey, Building Cost Analyses, Contemporary Timber Construction Elements

II ÖZET

Hipotez , *Türkiye'de ki inşaat sektörüne ahşap malzemeyi geri getirebilmenin olanaklarını bulmak. Türkiye'nin ahşap konusunda endüstri ve talep açısından potansiyeli bulunmaktadır. İnşaat sektöründe kullanılan methodlar içerisinde ahşap malzeme uzun yıllardır göz ardı edilmektedir. Buna rağmen, son yıllarda gelişim gösteren ahşap sanayii Avrupa standartlarıyla yarışabilir duruma gelmiştir. Bu pozitif gelişme, bilimsel araştırmalarla desteklenerek teknoloji bazında prefabrikasyon yoluyla üretim konusunda devam etmeli ve böylelikle gelişmiş ahşap strüktürel çözümler ülkemizde yeniden değer görebilsin.*

Amaç , gerekli olan ilgiyi, 21. yüzyılın inşaat sistemleri alanında getirdiği teknolojik yenilikler ışığında, yeniden ahşap sanayiine ve ahşap endüstrisine yönlendirebilmek ve Türkiye'nin sahip olduğu potansiyeli kullanabilmesini sağlamak

Yöntem, bu çalışma aracılığı ile Türkiye'nin saklı bulunan ahşap potansiyelini göz önüne sunmak.
Birinci olarak, eski yapım sistemleri ve yapılar araştırılarak çalışma içerisinde sunuldu. Buradan yola çıkarak çalışma, inşaat sektörü içerisinde ahşabın yarışması muhtemel olan çelik ve çimento sektörlerinin kapasitelerinin karşılaştırılması ile devam ediyor. Çalışmayı sonlandırmak adına da en önemli konu olan ve talebi doğrudan etkileyen, ekonomik uyumluluğu sunmak adına, İstanbul'dan seçilen bir betonarme projenin kaba inşaat bazında maliyet analizleri yapıldıktan sonra, bu yapının taşıyıcı elemanları ahşap elemanlara dönüştürülerek ve gerekli yeni ölçülendirmeler yapılarak yeni bir maliyet hesabı elde edilmiş ve bu iki sistem arasındaki karşılaştırmalar sunulmuştur. Ayrıca ahşap sistem için hesaplamalar, üretimin Türkiye'de yapılması ve yurtdışında ithal edilmesi durumlarına göre iki farklı şekilde ele alınmıştır.

Anahtar kelimeler, Türkiye'de Ahşap ile İnşaat, Türkiye İnşaat Sektörü, Bina Maliyet Analizi, Modern Ahşap İnşaat Malzemeleri

III TABLE OF CONTENTS

IV READING GUIDE

Chapter 1 – Introduction

The first chapter explains the motivation, aim, context of the thesis. It gives an outline of the work and the approach to timber buildings.

Chapter 2 – Historical and Technical Overview of Timber in Turkey

The second chapter shows the potential of Turkey in timber construction - history and gives brief definitions about the wooden systems that have been already used in different parts of the country.

Chapter 3 – Industrial and Production Overview of Turkey in Construction

The third chapter indicates construction market competitors of timber like cement and steel and their market share results. These results are shown in graphics. Further more a comparison between the Austrian and Turkish market is done.

Chapter 4 – Contemporary Structural Timber Elements and Examples

The fourth chapter points out contemporary wooden structural elements and shows examples of them on site.

Chapter 5 – Case Study, Cost Comparison between a Concrete and a Timber Structure

The fifth chapter compares the two different structural systems of concrete and timber based on an example building in Istanbul in an economical and technical point of view.

Chapter 6 – Results of the Thesis

The sixth chapter discusses the situation in Turkey with the given data in the work and makes suggestions for further development.

1. INTRODUCTION

Wood has been an important construction material during the past centuries. Most of the constructors choose it because of its structural and feasible preferences; it was used because it was nearby. Using timber as a structural element in multi-storey constructions in Turkey regarded without any benefits for a long time.
The reasons for this we can find in the high construction costs, due to regulations and a lack of knowledge of timber in structural and physical areas. Further more it was forbidden to construct in timber by legislations. This brought a huge loss in the knowhow, the education of professionals, the market, industry and standards.

1.1. Background

Timber structures were introduced to the construction market during the last decades. Constructing with timber by using its developed strength qualities and better properties in building physics became the main advantage and reason for preferring timber in residential buildings.

Nowadays in Europe, the production of middle-high rise urban buildings out of timber is a running trend. In every country it is possible to find erected buildings for residential or social use, like the Mühlweg Project in Austria or like the highest timber residential building in Europe with 9 storeys, the Murray Grove, located in England.

Figure 1_Highest residential building out

Figure 2_One of the three projects that was realized

1.2. Research Motivation and Objective

During and after industrialization and modernization years, new technologies and materials have been invented. Steel and concrete constructions were used instead of timber and they started to run the building construction sector. Especially Turkey, which is a country that used wood even in big cities as a main construction material for centuries, declined it and the knowledge about it and inserted other construction materials very fast and out of control.

On 17th of August in 1999, an earthquake disaster destroyed almost seven provinces in the north-west of Turkey and caused a high loss of life and property. In total, 18,373 people lost their lives, 48,901 people were injured, 317,493 dwelling units and 47,412 work places were damaged[1]. The main causes of that loss were buildings that have been collapsed. The damage ratio increased equally to the number of stories increased. 75 percent of the collapsed buildings were constructed out of reinforced concrete.

The main reasons for that catastrophe can be named as low quality concrete, poor detailing and engineering, poor construction techniques, but also inadequate inspection or observation of constructions and careless attitude of authorities in the application of building codes. The authorities were as guilty as the construction materials that have been chosen. Therefore, if concrete is not applied precisely or not with mechanical way, the quality of the end product is open to concerns.

Since then in Turkey it is a question why reinforced concrete frame structure were applied and still continuing to be applied in such a wide range (98% Istanbul). Even the Building Codes and the education in universities continue to direct the professionals to choice reinforced concrete systems and discount the alternative structural systems. It is obvious that reinforced construction systems need a fundamental revision and also alternative construction systems should be applied.
This study attempts to present the potential of timber construction which is one of those alternative construction systems, in Turkey. The study will present that potential within the context of history, productivity and economy.

1 Ministry of Public Work and Settlements, 2000

2. HISTORICAL AND TECHNICAL OVERVIEW OF TIMBER CONSTRUCTION IN TURKEY

2.1. Former Timber Constructions in Turkey

Turkey has a timber construction history which goes back until 17th century. By the early 17th century, timber frame construction for non-monumental buildings became popular especially in Istanbul, replacing or being combined with mud-brick construction. [2]

Figure 3_a wooden housing example from Black Sea Region of Turkey

While monumental buildings like mosques and palaces were constructed out of stone and brick, local housings were constructed out of wood frame. The reason, why wood frame constructions were favored is their seismic resistance to earthquake. That has been proved between the 17th and 20th century during several big earthquakes (1766-7,4 Richter / 1894-7,2 Richter / 1903-6,7 Richter / 1912-7,3 Richter / 1924-6,8 Richter / 1930-7,2 Richter /etc.)[3]

Figure 4_a wooden housing example from Marmara Region, Istanbul

2 Tobriner Stephen,(2000), Wooden Architecture and Earthquakes in Turkey: A Reconnaissance Report and Commentary on the performance of wooden structures in the Turkish earthquakes of 17th August and 12th November 1999, International Conference on the Seismis Performance of Traditional Buildings, Istanbul, Turkey, Nov 16-18

3 Boğaziçi University, Kandilli Observatory and Earthquake Research Institute

Although they had seismic resistance to earthquakes, wood frame structures were deadly in case of fire. Huge fires at the beginning of 20th century smashed lots of housing units and forced authorities to forbid wood frame construction unless they had a brick layer of protection.

These regulations cut the demand for timber housing and left some neighborhood and some examples standing. Preserving the fabric of those few neighborhoods where there are still wooden buildings has long been a priority in Turkey and there is a wide raft of legislation to protect listed historical buildings.

Figure 5_A street from old Istanbul with timber buildings

There could be done more to find a better balance between the protection of properties and the encouragement of sensitive renovation.[4] Too many buildings – like the orphanage in Büyükada (Princess Island's) – are simply left to decay. Besides all of that, an obvious property of timber houses is that they survive earthquakes. Wood houses are far more durable than popular belief.

Figure 6_Orphanage in Buyukada(Princess Islands)

As mentioned above, timber construction was not favored anymore as before in Turkey. There are several reasons to explain that situation. Economy, industry, politics are these days' problems. But also there were other causes in the past. Because of those reasons and their consequences, the traditional timber houses which were standing in Anatolia until 17th century, were abandoned and forgotten.

4 Finkel, Andrew: Wood culture and Timber Houses

2.2. Distribution of Timber Housing in Turkey

Timber houses were built in many parts of Turkey, also in regions which are sensitive to earthquakes. Turkey has been without significant timber resources for a long time. Very little examples remain from traditional timber buildings.
In Anatolia it was not different to Istanbul about timber construction. Anatolia always has been the bridge between nations and cultures.

Figure 7_Building Typologies of Different Regions in Turkey

The development of the classical "Turkish House" also has been influenced from many cultures and can be considered as a synthesis of the background[5].
Timber construction can be seen in rich forest areas such as northern, western and coastal parts of Anatolia. There are still timber houses standing from 17th century, whereas the majority of them dated back at 19th century.

- ***Black Sea Region***

In traditional Turkish architecture, the socio-economic and cultural structure of the family defines the planning of the houses. The structural preferences for the construction are related mostly to the environmental conditions. Since in Black Sea region, forest areas are dominant, wooden houses are seen more in comparison to other regions of Turkey.

5 Hersek, M. Can, (2001), Domestic Wooden Houses of Turkey, Naturopa, Trees Between Nature and Culture, European Council No: 96

Besides, in this area the whole life was related to wood such as buildings and ships for fishermen, coaches, tools and traps, furniture and children's toys. Skills in handling wood was one test of man's estate[6].

The construction techniques are also different from west to east and generally the knowledge of carpentry passes from master to apprentice, so that we can not actually speak about technical data but different techniques[7].

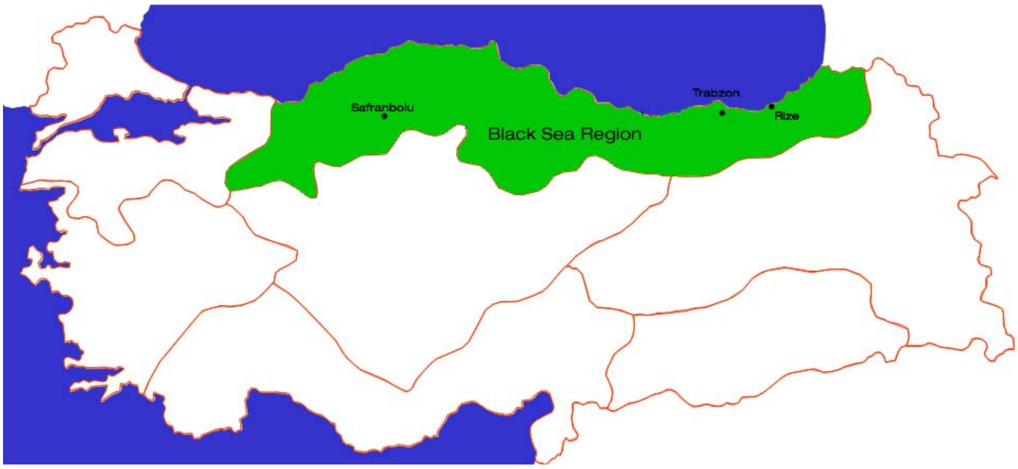


Figure 8_Black Sea Region

In Black Sea Region there are specific locations with traditional timber houses. Safranbolu and East Black Sea Region especially come forward.

- ***Safranbolu Houses***

Safranbolu is the village on west black sea region with a population of 47.257 persons. That village has 2000 traditional Turkish houses and out of that 800 are selected to UNESCO world heritage. [8]

The life style in that village is well preserved since 18th century and it shows the Ottoman way of living to the visitor and to the inhabitants. For not causing any damage to the houses in that village, after 1940's just restoration and maintenance aspects took place. Since 8th October1976, the village is protected and preserved by the legislations too.[9]

6 Hersek.

7 Arın Süha, (1986) DVD, Documentary, When the Fog is Swept Away

8 http://www.safranboluevleri.net/varyasyon.asp

9 http://www.safranboluevleri.net/varyasyon.asp

Safranbolu is surrounded by forest areas and this is the reason also why timber construction materials were chosen. It is +300m sea level and the average height of the livable area is +500m[10].

Figure 9_a view of Safranbolu Houses

- ***East Black Sea Region***

Most specific construction system for this region is skeleton system which is filled with wood or stone. According to the filling material or combined technique, that system takes different names.

If the filling material is 5-6 cm thick and 30-40 cm wide planks, this was called “block timber filled”. In this system the planks had to be applied to the facade as the construction went on. Otherwise it wouldn’t be possible to fill those frames of timber studs cut with grooves.[11]

If the filling material is smaller then in “block timber filled”, it was called “cell filled”. The biggest difference between that two systems is the filling material. In “cell filled” systems, cut stones were used for filling the frames.[12] The gaps between the frames and stones were also covered with mortar as a finishing.

There is a very nice example of that kind of construction type in city of Trabzon, Sürmene. A villa which was constructed almost 150-200 years ago is still standing and also represents a nice example of renovation.

Figure 10_ Memiş Ağa Konağı, Trabzon, Sürmene

10 http://www.safranboluevleri.net/varyasyon.asp

11 Göksan, Serkan ; Wooden Houses-Wood Based Houses, www.serki.com

12 Göksan

- ***Marmara Region***

In Marmara Region, Istanbul is the city that gets the credits. It was the capital of Ottoman Empire on 19th century and after the war the city population started to increase inevitably. Also in Bursa, in a village called Cumalıkazık, there are very specific kinds of Turkish houses.

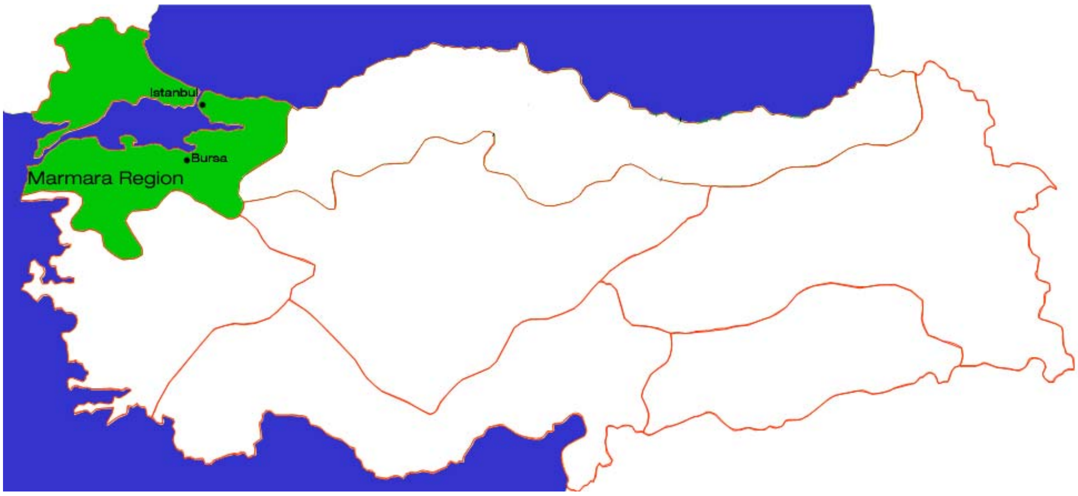


Figure 11_Marmara Region

- ***Istanbul Houses and Sea-Mansions***

Demand for housing in Istanbul rose during the nineteenth century due to the invasion of immigrant populations. Wood houses reflected this demand and more densely populated neighborhoods arose of much smaller dwellings. A popular element of houses from this period was the bay extensions (cumba) or cantilevered overhangs in which the house itself appeared to stretch out in search of a better view. These not only provided extra space for upper storey rooms but shelter and shade for the pedestrians below.

The Bosphorus - Known in Turkish as *Boğaziçi*- it links the Black Sea with the Marmara Sea. It is 30 km long, running in the general direction of north to south and varying greatly in width from about 700m at its narrowest to more than 3,5km at its widest[13].

13 www.turkishculture.org

With the shores rising to heights up to 200m, lined with palaces, ruins, villages, and gardens, the Bosphorus is one of the most beautiful stretches of scenery in Turkey. Along with the Ottoman summer palace "Köşk"s, people can also see many of the old and beautiful Ottoman wooden seaside mansions, called "*Yalı (Sea Mansion)"*. The *sea mansions* were originally intended as a summer house. The central area has a wooden dome with large bays on three sides; a continuous row of low windows in these bays allow cool breezes to blow through and offers views of the Bosphorus in all directions. In the Bosphorus, the shore is decorated by many *sea mansions*, most of them built in the 19th century. Some of them are very old and have a fascinating history with a series of owners.

On the Asian side, the oldest *sea mansion* between *Kanlıca* and *Anadolu Hisarı* is the red painted *Köprülü Amcazade Hüseyin Pasha Yalı'sı* (1699, clearly sported the wealth of its owner – a member of the Köprülü family, by being entirely covered in wooden planks). The oldest *sea mansion* on the European side is the *Şerifler Yalı'sı,* built in 1782.

Figure 12_Köprülü Amcazade Hüseyin Paşa Yalı'sı, 1699

Wood was clearly the material of choice before the First World War in Turkey, its popularity only affected by cost. The lime-plastered rubble facades were vulnerable to salt and sea air and the so the sea-side mansions along Istanbul's Bosphorus were among the first houses to use timber cladding.

2.3. Vernacular Wood Construction Techniques in Turkey

Turkish timber houses have significant types of construction with the way of structuring them. After the earthquake of 1999 the engineers who came from other countries to examine the conditions of the buildings were surprised with the way of timber constructions in Turkey but also disappointed that they were not used anymore. Learning from the past and applying it to modern systems should be the focus point.

- ***Bağdadi***

In this type of construction, small lumbers in dimensions of 10-20 mm are nailed in and out of the structure in every 20-40 mm. Those elements reinforce the walls and increase their bearing capacity. The gaps in between those pieces are filled with the tree barks or some small stones for insulation purposes[14].

Figure 13_Bağdadi System Example

- ***Çantı (Log Houses)***

That kind of structures can be found on northern regions of Turkey where forest areas are common like Bolu, Gerede or East Black Sea Region. For that construction system, logs with 0,30-0,35 m diameter are put on top of another horizontally[15].

Figure 14_A modern Çantı System Example

In rural area that kind of houses are constructed without technical knowledge but with traditional spirit. There is no foundation but big rocks or low height stone walls act like foundation and the lower levels of the logs sits on them. Approximately 8-10 logs high create one storey. The second floor comes after those logs. Against the air and outside conditions the logs are covered with mud from interior.

Vertical loads are transferred from those logs through the system starting from the top till the bottom and than the foundation. Since those logs are weak against horizontal loads building more than one storey buildings are not so suitable in case of wind or earthquake areas.

Excessive use of wood for this construction is a reason why it is not preferable anymore. Also it is not allowed by the construction regulations[16].

14 Göksan,

15 Doğangün, Adem; Structural Systems in Timber Building in History; KTU, Trabzon

16 Avlar E (2002) , Design of timber frame structures, YTU, Istanbul

- ***Daraba (Picket Fence)***

This construction type is preferable in northern regions of Turkey in rural areas. In this construction system planks with 5-6cm thick and 0,20-0,25m width are used. Like in log houses that planks put on top of each other. On the corners there are knot joints. For protection from outside conditions mud or plaster cladding applied from interior[17]. This kind of construction is very old in that region and the constructors built with tradition and custom methods. But again like in log houses usage of that system with irrational amounts of wood is harmful for the forest. That's why this system is also not allowed anymore according to Forest Regulations[18].

- ***Karkas (Wooden Skeleton)***

In this kind of construction the structural elements are designed as a skeleton system. The forces are transferred by studs, beams and diagonals. This buildings rise from 50-60cm high foundations. These foundations made from stones or concrete average 50cm thick. Afterwards 10cm thick concrete girder graded over that foundation walls for the base wooden planks which are 10x10cm. For protection against decay, bitumen is also applied to those base wooden planks. After foundation is constructed the main studs with dimension of 10x10cm, from 50cm to 150cm distance from each other are pressed to the base planks.

Those studs create the first storey and to the top of them 10x10cm beams are embedded. According to the cladding or filling material, the empty areas between studs are made tighter with diagonals (6x10cm) or mid-beams (yoke). Maximum floor height is 2,90m in this construction method. According to filling material, this system takes different names;

- Stone filled (himis)
- Brick filled
- Adobe filled (kerpic)
- Covered with planks (bagdadi)
- Covered with planed planks
- Wood filled (dizeme)

17 Göksan

18 Göksan

2.4. Timber Constructions in Turkey at the Present

- ***Why timber constructions are not favored anymore?***

    - ***Modernization***

One of these reasons is modernization. After the First World War, Ottoman Empire had big crises and the country was divided between the entente powers (England, France, Russia and USA). On 1919 the Independence War started against that forces and lasted 3 years in Anatolia. When the war was over with victory, M. Kemal Ataturk and his fellows found the Republic of Turkey on 1923. This meant revolution, transformation in a new era. The country had to be constructed again. Because the war was in Anatolia, the population in the rural areas was the most affected. Also at the end of 19th century the industry revolution in Europe brought new devices and modernization to every sector. Those days work in the land was done by 10 workers but with the development in the machinery one two workers were enough. Opening factories and supplying work also didn't help so much to the people in the rural area. They started to search for new possibilities and immigration to the big cities was the first option.

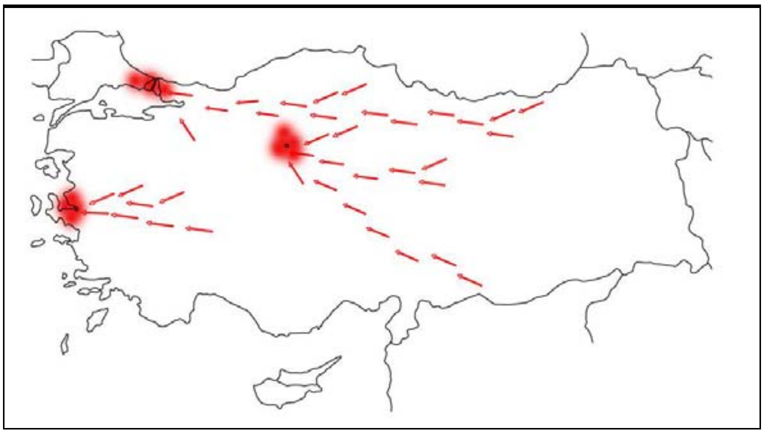


Figure 15_Domestic Immigration roads of Turkey

Cities like Ankara, Izmir, and Istanbul were the one's affected the most. The population increased rapidly. Cities couldn't catch up with that velocity and this also affected the urban fabric. Istanbul is one of that cities in which the damage of immigration can be visible in urban fabric and building typology.

Years	Total Population	City Population	Rate (%)	Land Population	Rate (%)
1960	27.754.820	8.859.731	32	18.895.059	68
1970	35.605.176	13.631.101	38	21.914.075	62
1980	44.726.957	19.645.007	44	25.091.950	56
1990	56.473.035	33.326.351	59	23.146.684	41
2000	67.803.927	44.006.274	65	23.797.653	35
2007	70.586.256	49.747.859	70.5	20.838.397	29.5

Figure 16_Population Difference between City and Land in Turkey, last 50 years

At the beginning of the 20th century, when the city was not so crowded, people tend to live close to water areas and around the Bosphorus. The population of the city was around 1 million. [19]

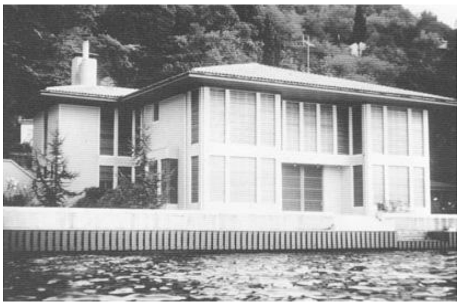


Figure 17_Map of Istanbul on 1916-1934-196

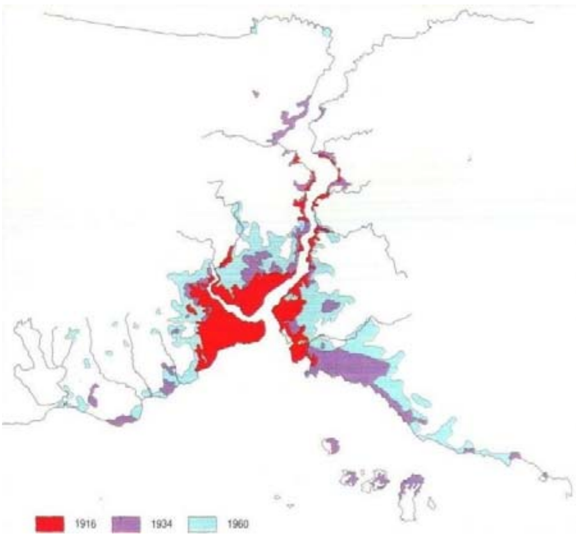


Figure 18_Example from urban fabric of Istanbul. People were living close to water area.

But year after year the city started to get overpopulated. The limits of the city reached 5712 km² and the population is almost 15 million. That makes 2420people/km2. [20]

19 http://tr.wikipedia.org/wiki/%C4%B0stanbul

20 http://www.istanbul.net.tr/istanbul_istanbul_nufus.asp

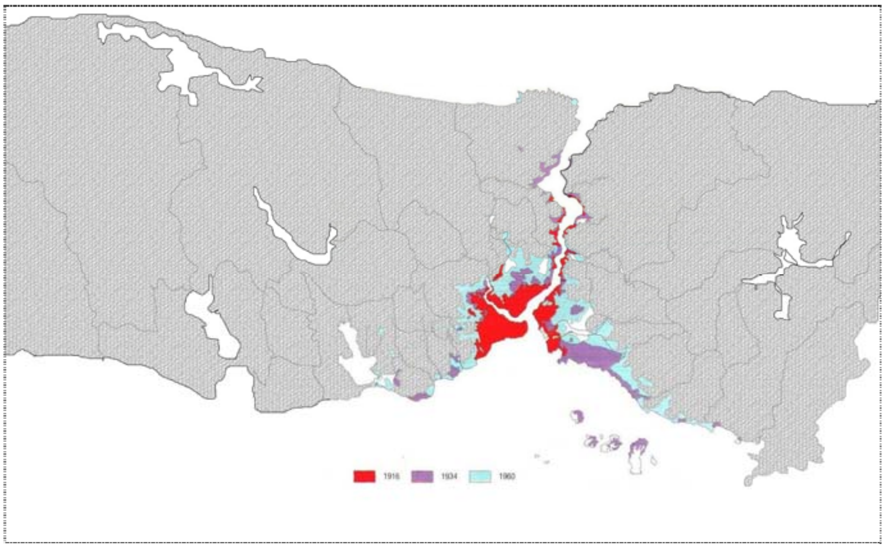


Figure 19_Map of Istanbul on 2008

As immigration increased the demand for housing also changed. Socio-economic differences created big gaps in the community. Besides that the insufficiency of the existing policies and economic resources to develop new land to accommodate the fast rate of urbanization had caused reconstruction of cities over the existing urban fabric.[21]

The constructors' intentions were canalized to make profits from those settlers and for that purpose they dominated the politics even. Nowadays according to the legislations it is not allowed to construct with timber more than 2 storeys.[22]

Figure 20_new urban fabric of Istanbul, 2008

If you have a big demand for housing and for the same size of land, instead of constructing 2 storey timber houses, constructing 5-6 storey concrete apartments are more favorable. So during the last century, high rise concrete buildings took the place of 2-3 storey timber buildings. Some of them burned down or collapsed because of attention lack.

21 Guchan, N. Sahin,(2005) Observations on Earthquake resistance of traditional timber framed houses in Turkey, Published Diploma Thesis, METU, Department of Architecture, Ankara, Turkey

22 Building Codes, Yapı Yönetmeliği, ,Ministry of Public Works and Settlements, Turkey

Some of those which can still stand are under protection with the legislations but still it is possible to hear in the news about any burned down old timber sea-mansion or a collapsed house in the city by accidents.

- ***Fire***

Another reason that people don't favor timber constructions is fire. Fire is a big enemy of wood based constructions and Istanbul was a city plagued by fire in the nineteenth centuries, but this was not because the houses were made of wood but because they were close to each other. Wood burns but the structure normally stands for an hour and a half. Steel frame buildings collapse much quicker.

Because of the big city fires at the end of 19^{th} and at early 20^{th} century Istanbul lost nearly 20.000 timber housing. After that it was forbidden by the authorities to build with timber unless they had a brick layer of protection.

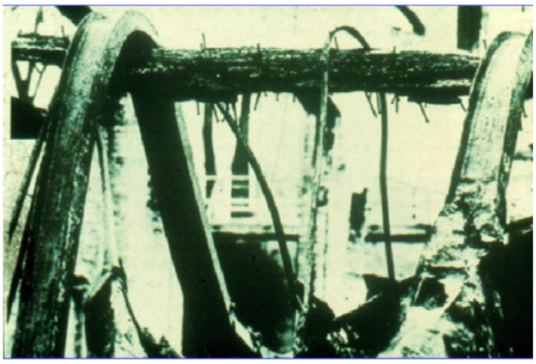


Figure 21_behaviour of wood and steel in case of fire

- ***Mentality***

The other myth is that wood is a limited material and to use it for construction is to weaken a natural resource. The reality is that demand creates rationality. One of the UN's environmentalist slogans is "Cut trees to save the forests". In societies where people use more wood, the forest size increases[23].

Another point is education system in Turkey doesn't cover the wooden structures or engineering. The knowledge and the potential have lost. The professionals that are graduated from universities as architects or engineers don't know about timber and it's potential.

23 Forestry Outlook Study for Turkey (2007), Towards the 100th Anniversary of the Republic of Turkey, OGM

In the past, when a constructor built a wooden structure, he/she let the apprentice to learn with him/her and that way the knowledge passed through the ages. But since a long time because of the prices, those apprentices who became master can’t work with timber and let others to learn.

- ***How Timber Constructions Became Favorable Again?***

    - ***Earthquake***

Actually earthquake is not something new for Turkey but last one opened the minds and forced people to think about what was the reason of that big loss. The last earthquake on 17th August 1999 caused high loss of life and property. The main cause of that loss was the buildings that have been collapsed. The damage ratio increased as the number of stories increased. And 75% of that collapsed buildings were reinforced concrete.

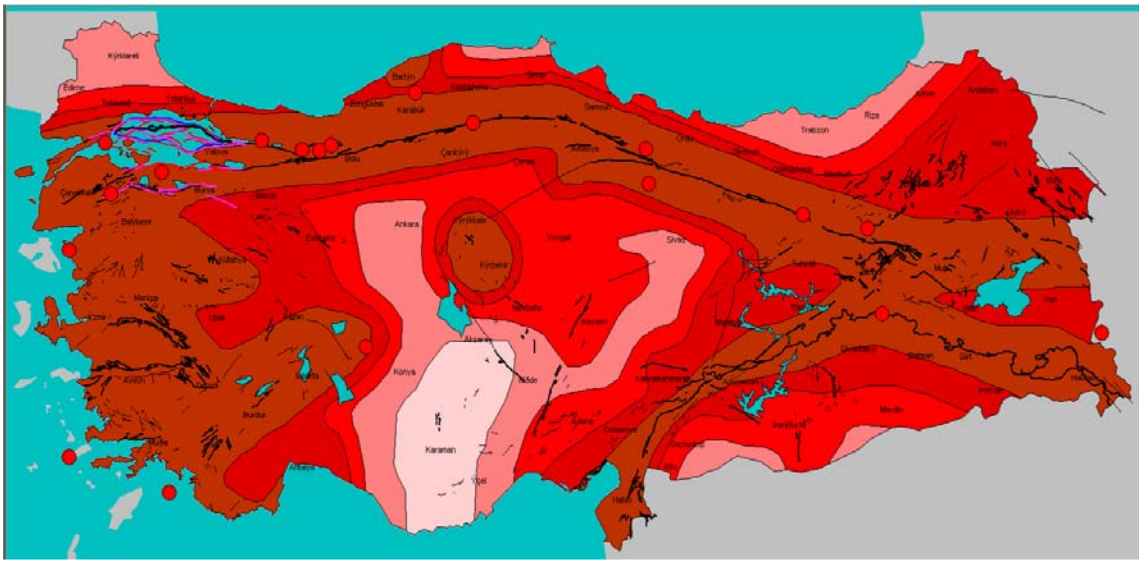


Figure 22_Earthquake Zones Map of Turkey

As its known, timber constructions are working in ductile mode enough flexible to survive earthquakes. The property of wood is to be flexible without breaking and to return after bending to its former shape. If beams and columns are sufficiently strong and flexible, braced and tied together they work as units. If the building can be constructed with the proper material and good workmanship, the resistance to earthquake will be higher. As an argument it can be said timber skeleton systems are safer construction types in comparison to the concrete constructions.

After the earthquake of 1999, not just temporary and single family housings but also earthquake resistant strong structures should have been constructed in Marmara Region.

To support that argument it has to be explained why timber structures are safer than concrete systems during earthquakes. During an earthquake the ground shakes and moves. That movement affects the building and therefore the building also tends to move and shake. Forces that occur during the earthquakes because of the movement are transferred through the building by the structural elements like columns, beams and ceilings. Therefore construction material should be durable to those forces, otherwise as happened before the building would collapse. Also heavier the building greater the forces to transport or in another words lighter the construction material lower the forces moving through the structure. But for that reason it wouldn't make sense to use any light material. The material should have a great percentage of durability due to its weight which is in wood higher than any other construction material. (1m^3 steel = 7800kg; 1m^3 concrete = 2350kg; 1m^3 wood = 650kg)

There are several examples and reports about the timber building that have survived several serious earthquakes in Anatolia and also in other countries. For example according to Doğan Kuban, a famous Turkish architect, the timber frame in Turkish houses, resists earthquake well because it's tied together in boxes and panels. *"The main structural system in the Turkish houses was a timber skeleton used essentially over the masonry walls of the ground floor … The connection between the horizontal and the vertical elements didn't allow for continuity as in a modern structural skeleton. The continuity was not through the elements, thus linear, but it was like a box system where all the elements were integrated for the stability of the system. The primary and secondary uprights between the floors, horizontal elements, floor beams and diagonals have constituted panels and boxes. This system responds well under the stress of earthquakes. "*[24]

24 Tobriner

Also *'1999'* was not the first and the last earthquake. Another big earthquake on 1510 hit Istanbul and brought new ideas about the use of timber. A short travel in the history can bring a information from this year, saying *"... in spite of this, the habit of building higher ordinary city houses in masonry must have been prevented by bringing into force some legal measures: after the destruction of 109 mosques, 1070 houses and most of the fortification walls during the earthquake of 1510, 37000 workers from Anatolia, 2900 workers from Rumeli, 10000 workers of Istanbul were recruited in order to reconstruct the city in timber "*[25]

Also from another researcher we are able to get that following information after the earthquake of 1894*; "…Besides, the merit of being timber reduced the loss. It most be greeted with pleasure that the buildings in Istanbul are not entirely built of masonry as in other regions. If this was the case the loss could have been more serious. The timber-framed buildings have resisted the earthquake amazingly. While some old timber structures of a mediocre quality were still standing, some well built, nice and new masonry buildings, even the ones joined with steel, were destroyed."*[26]

Construction in wood represents not just an important aesthetic which helps us to define Ottoman urban life, but embodies a great deal of practical knowledge that in a country with Turkey's seismic history, could actually promote both safer and more environmentally sensitive housing.

Accept Anatolia there are examples from other regions of the world such as Lima, Lisbon or Giumri. In Lima after the earthquake of 1746, masonry was restricted to the ground floor and lighter more flexible wood construction was used above. The wooden system used above named as *quincha,* in which wooden framework was filled with waddle and daub[27].

In Lisbon after the earthquake of 1755, the military engineers founded a system called *gaiola,* in which X-braced internal wooden frame used to support the exterior masonry walls above the ground floor[28].

25 Arel A. (1982), Problems in Ottoman Housing Tradition Through the History , EUGSF Yayinlari;, p.70

26 Oztin F, (1994) 10 July 1894 Istanbul Earthquake Report. Ozyurt Matbaacilik; 6,

27 Vardan Mkrtchyna, D.Arch.D.Trans., The 1988 Giumri earthquake : some thoughts and conclusions on the comparative performance of traditional and reinforced concrete buildings

28 Vardan

In Giumri (Armenia), during the 1988 earthquake, destruction was caused mainly to reinforced concrete buildings or buildings of mixed construction, combining masonry with reinforced concrete. 19th and early 20th century masonry buildings with timber floors and roofs have suffered only slight damages. The percentage of collapse within the historic monuments in the earthquake zone is only about 5%. [29]

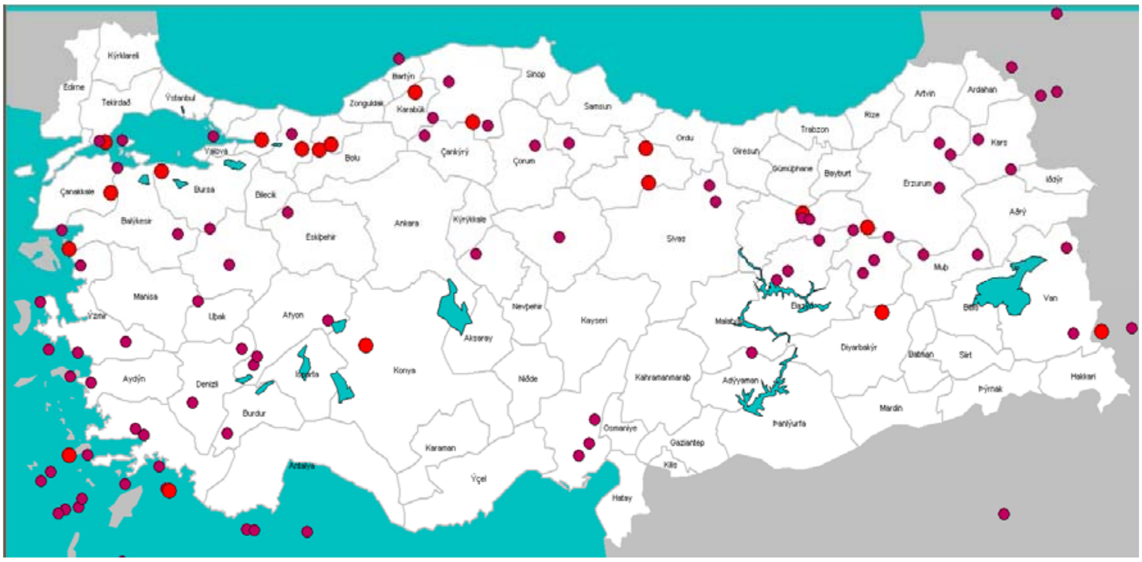


Figure 23_Earthquakes in last 100 years bigger than 6 Richter scale

The earthquake map of Turkey actually shows clearly the risk zones and the potential of big earthquakes. In last 100 years there have been 19 earthquakes in scale bigger than 6 Richter.

- ***Imported Housing Systems***

“New” timber construction in Turkey actually started in 1980’s with the relaxation of import regulations to allow kitset houses mainly log houses. In 1983 the North American’s gave seminars on light timber frame construction and since then there has been a steady growth. [30]

After the earthquake of 1999, that demand has reached the highest point. Developers and investors found new ways for construction market. The timber and steel-frame building systems were introduced to the market and mostly available for use of high-income level groups.

29 Vardan

30 Walford Bryan, (2003) , NZ Timber Design Journal – Issue 2, Vol.12, Seminar at the Istanbul Technical University

These systems were simple to mount and suggesting fast-clean-safe constructions. Citizens of Istanbul were afraid of earthquake and it was told that this was not the last. The investments for housing sector dropped suddenly. But those new imported technologies, fully intelligent houses got high demand.

Constructors were providing so called 'satellite cities' out of Istanbul and building those houses on that areas with prices from 450-1000. Not everybody can afford that of course, but there was demand.

Figure 24_A satellite city example, Istanbul

One of the associations in USA called US Wood Products Building Program is founded for creating conscious and improving the knowledge about wood products and technologies. That program also works in Turkey. They are planning to build timber prototype houses for exhibitions and introduce them to the market. They have companies like Wickes International, First Renaissance Ventures and APA-The Engineered Wood Association as members.[31]

Figure 25_Timber Housing Examples From Istanbul

Figure 26_Timber Housing Examples From Istanbul

Also again American, Michigan Town&Country or Slovenian Riko and Canadian Nascor are some of the companies who are working with Turkish distributors. While Town&Country is specialized about log houses, Riko and Nascor are building with panel systems in Turkey.

31 Walford

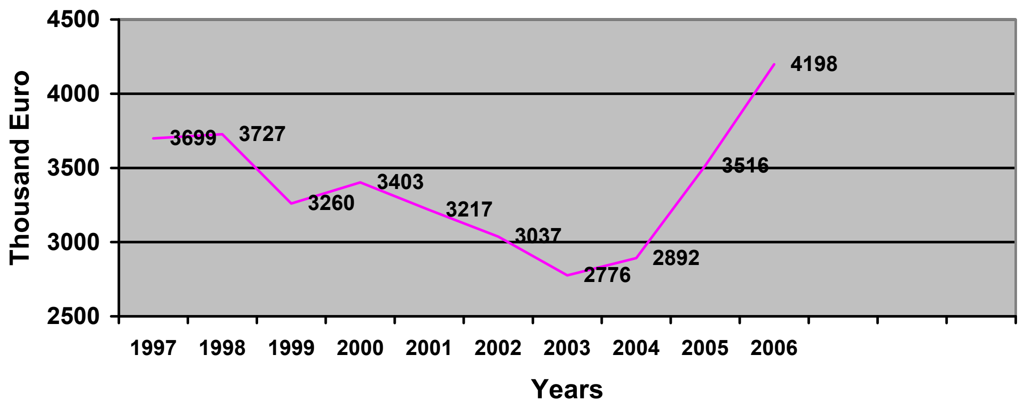
3. INDUSTRIAL AND PRODUCTION OVERVIEW OF TIMBER IN TURKEY

3.1. Overview Of Construction Sector

Construction sectors are the big running engines of economy. That sector gives opportunity to hundreds of different materials to be in the market, creates lots of working fields and gives socio-economic balance to the economy.

In Turkey according to the surveys, after 1988 the construction sector had a slow down. Especially after the earthquake on 1999 there was a big decrease in the investment to buildings and due to that to construction sector affected. In order to supply new housing to the society, new legislations and tax system has been developed within the year 2000 and the sector started to grow again. Except during and after the economical crises on 2001 the sector kept on growing[32].

Turkish Construction Sector from 1997 until 2006



Especially with the effect of industrialization and population increase, the socio-economic balances have changed and people started to immigrate to cities. This over-population in the cities led construction sector to develop parallel. There have been a lot of investment for making the living standards higher and setting the sustainable infrastructures in the cities, as a result construction sector had to face those requirements.

32 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, YEM

The construction methods and systems that are used in Turkey shows a big difference after 1920's. Before the foundation of Republic (1923), majority of the buildings were out of timber, mud brick or cut stone. Nowadays society has a belief that concrete is the strongest and the safest way of construction. In Turkey %98 of the housings are out of concrete while this ratio is %15 in U.S.A, %5 in Canada, %50 in England and %30 in Scandinavian countries. [33]

During the modernization times, preservation and planning activities were slowly developed and redefined to control and direct this unexpected change until the 1940s. However for faster and planned development, investments in industry, agriculture and transportation sectors were rapid. Especially, mechanization of agriculture in the rural areas pushed people out of villages to cities. Efforts due to that internal immigration from rural to urban caused to the loss of urban fabrics. More population brought the necessity of medium-high rise building in those cities. But this very rapid increase trapped the cities without preparation and planning. It was not possible to control every construction and quality of the material that has been used. Therefore, by the end of 1960s, the traditional parts of the cities became the main arteries and led to loss of public in related types of timber framed constructions.

The internal immigration affected existing policies and economic sources. A fast rate of urbanization was necessary and the led to reconstruction of cities over the traditional and existing urban basics. Parallel to these transformations taking place in the planning field, certain construction techniques began to be favored extensively as modern. Especially after 1960s the concrete frame system was accepted as the only option and was used all around the country. As a result of that wave the traditional timber-frame houses were abandoned and almost forgotten.

First concrete based constructions were for the roads which were demolished during the Independence War and supposed to connect the cities to each other. That's why until 1950's and 1960's the major investments on construction sector were on infra-structures and public areas.

33 Erengezgin, Çelik; Timber and Ecology

But unfortunately on 17 Aug 1999, last biggest earthquake of Turkey proved that constructing with concrete was not the safest way.

Figure 27_Izmit, after the earthquake

3.2. Timber Industry

In Turkey wood based construction materials are used relatively more after the earthquake of 1999. Since the industry requires organic based production, it's also healthy and environment friendly. On the other hand the industry is developed about MDF, OSB or chipboard production in the recent years recent (figures are 3 million m^3 MDF and 2 million m^3 fiber board, all together around 7-8 million m^3) and Turkey has found a place among leading countries in Europe in terms of the production capacity. They all modernized their technology reaching to the level of state-of-art enterprises able to compete in world markets. The use of the capacity is quite high and most of the products are exported. Many of these companies are now in joint ventures with their European Partners[34].

About timber production Turkey has 129 companies registered to the UAB (National Timber Association). There are also 8.000 plants from which 7.900 make sawing[35]. Those companies are using the resources from a forest area of 21,2 million hectares. However from that capacity 50% of it is effective. Since timber production is related to forest area and its capacity, Turkey has a problem in that part.

34 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

35 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

According to the statistics, world's timber production is dominated by America and they are at top of the list with 40% of industrial timber production rate. That 40% means 428million m3. Europe has 30%, Asia 13%, South America 10%, and Africa 4%. In Turkey there is a capacity of 11 million m3 industrial wood production and 13,2 million m3 consumption and with that Turkey is the 11th country in the rankings for timber market[36].

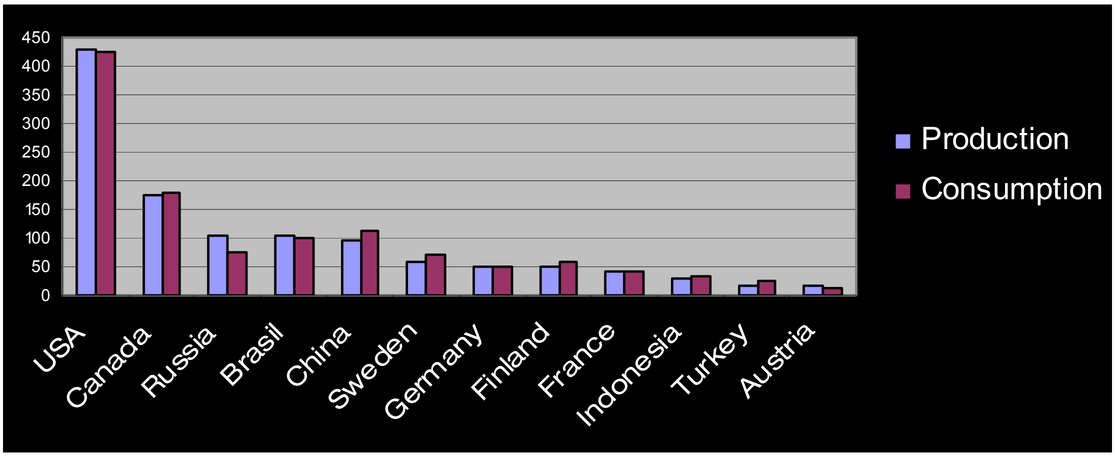


Figure 28_Timber Production and Consumption in the World

The annual wood based product consumption is around 24 million m3 in Turkey. 13-14 million m3 of that demand is provided by the production capacity of GDF (General Directorate of Forestry). 9 million m3 of this production is for industrial use and the rest is used as fuel-wood. This production meets about 75 % of the domestic round wood consumption. Private forests and agricultural land provide 3.3 million m³ industrial wood and of 1.9 million m3 fuel-wood to market. The remaining demand is met from imports[37].

Production of round-wood from state forests has dropped from 23,2 million m³ to 13,2 million m³ since 1980. This drop mainly occurred in fuel-wood production (%64). At the same time, the share of thin material has increased and the share of logs has decreased (from 5.5 million m³ to 3 million m³) in total production. This drop has mainly attributed to the increasing use of metals and plastics in the construction sector and introduction of new technologies that uses chipboards, MDF and OSB in the furniture sector[38].

36 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

37 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

38 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

The production trend signals a stable curve with a slight increase in 20 years, the increase will mainly be in chip & fiber wood and pulpwood. Fuel-wood production is expected to decrease while wood production for energy purposes may increase. The main consumption of timber is for high-standard of villa constructions or squatter's house. For normal housings, structural timber is very rare. Besides that as window or door elements plastic is more favorable than timber.

The biggest problem of timber in Turkey is customer unconsciousness. Timber has to be introduced to the market as an option for constructions and with marketing or promotions the industry should be encouraged. Also getting information and data about timber in Turkey is very difficult. There a lack of information and update of the knowledge. Also about the grading and prefabrication, industry is not developed enough for timber production. As a result, bad quality of material is consumed in the market and public has a wrong impression about timber.

3.3. Forestry Industry

For producing timber, a developed forestry and effective forest areas are main necessities. The main producers of wood based materials in the world have big areas of forests and high-developed industries feeding that market. Turkey is importing wood products mainly from European countries like Russia (46%), Ukraine (38%) and mainly *pine* from those countries (73%)[39].

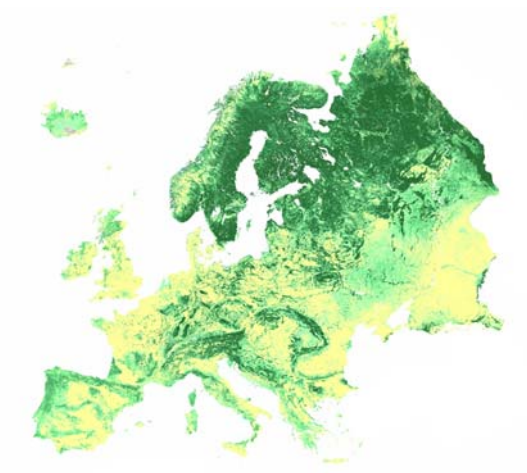


Figure 29_Forest Areas by VTT

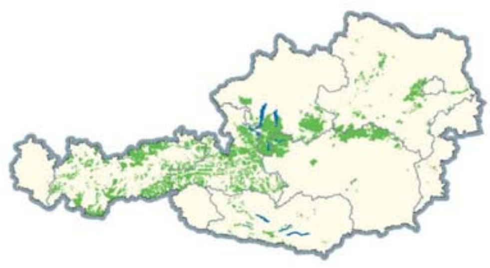


Figure 30_Austrian Forest Areas

39 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

The first organization of forestry in Turkey goes back to 1839 but the first forest declaration of the Republic of Turkey applied in 1924 and the present Forest Law (No 6831) has been in effect since 1956. All forests were nationalized in 1945 and soon after the country entered to multi-party political system, forests were given back to their former owners[40].

The first regular and scientific record about the forest areas in Turkey was done in years 1963-1972. Management plans for all forests were completed in this period. According to the plans the total forest area was 20.199.296 ha, of which 11.342.889 ha unproductive. The total forest area was divided almost by half to high forests and coppices[41].

Since 1972, each year plans for almost one tenth of the forest area have been renewed. But, because of the frequent changes in borders and planning units, the Management Planning Department was not been able to compare the results of inventories at yearly basis until 1997. The figures indicate that there has been an increase of 857.147 ha forest area for the last 30 years. The last figures show that there are 21,056,443 hectares of forest in Turkey. There is an increase of 857.147 ha when compared the first regular inventories done in 1963-1972[42].

	1963-72	1997	1998	1999	2002
High Forest	10.934.600	14.283.312	14.347.965	14.418.340	15.175.389
Coppices	9.264.689	6.429.584	6.385.808	6.344.908	5.881.054
Total	20.199.296	20.712.896	20.733.772	20.763.248	21.056.443

Figure 31_Forest Statistics of Turkey, MEF Statistics Division, GDF Management Planning Department

40 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

41 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

42 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

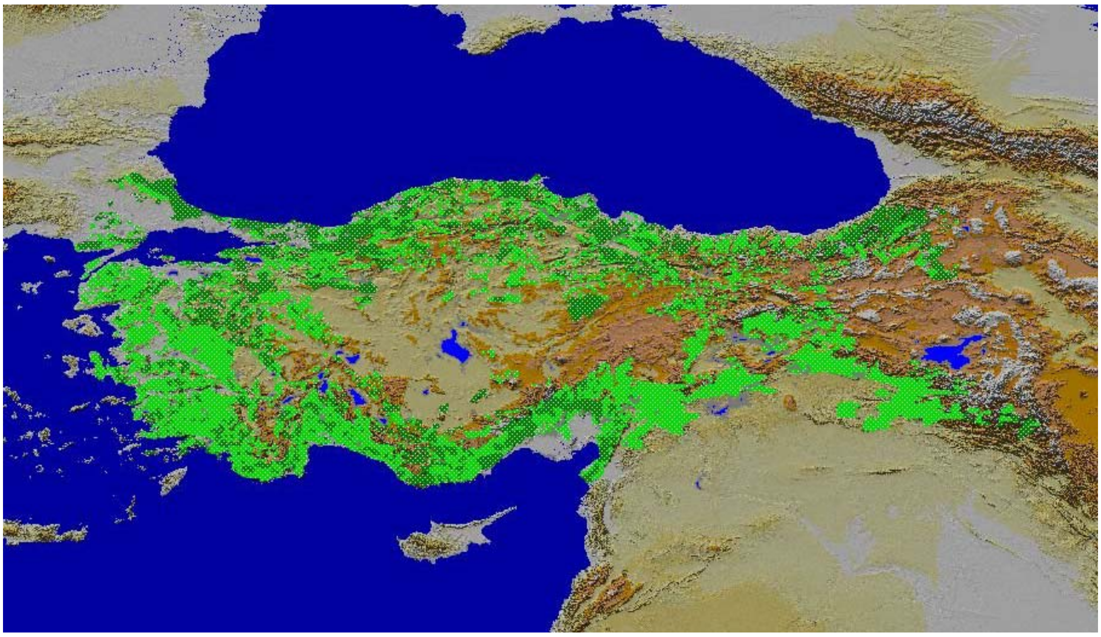


Figure 32_Forest Areas of Turkey

Forests are generally located on mountainous areas and they are usually natural and semi-natural with high biodiversity. Turkey has almost 9000 plant species of which 3000 is local. Most of these plants are located in forest areas. Temporary forests are common and relatively uninterrupted along northern Turkey. Coniferous forests, depending on the species and locations, are found at varying altitudes from sea level to the timber line. Forest formations of the country include species belonging to different floristic regions, namely Irano-Turanion, Mediterranean and Euro-Siberian. Approximately 800 woody taxa occur in the country's forests. The predominant species are *Pines, Fir, Spruce, Cedar, Juniper, Cypress, Beech, Oak, Alder, Chestnut, European Hornbeam*[43].

The general thought is that the forestry industry will even more develop in the near future and will spread to neighboring countries where wood prices are more favorable. But still the domestic demand will stay higher than domestic supply.

43 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

Type		2003		2004		2005		2006	
		YTL	$	YTL	$	YTL	$	YTL	$
Pine	m3	108	90.56	133	111.52	137	114.88	157	131.65
Spruce	m3	106	88.88	129	108.17	136	114.04	159	133.32
Beech	m3	155	129.97	133	111.52	133	111.52	143	119.91
Oak	m3	121	101.46	112	93.91	116	97.27	138	115.71

Figure 33_Log Prices in Turkey

Turkey is considered rich in terms of NWFPs (Non Wood Forest Products). Many tree, shrub and herbaceous plant species naturally grow in the Country. Most of the NWFPs are collected by forest villagers at low prices. Permission and amount which should be collected decided by GDF so that endangered plant species are protected to sustain the biological and genetic diversity. Some essential non-wood products are resin, storax, leaves, fruits, barks, corms of some species, incense, oak gull, mushrooms, and etc .[44].

- ***Forestry Development and Strategies***

The Forestry Policies in Turkey have been about protection of forest areas, sustainable supply of industrial and fuel wood to meet the domestic demand, supply of non-wood products, rehabilitation and reclamation of degraded forest areas, establishing and expanding national parks and protected areas, protecting wild-life, providing social services such as recreation, hunting etc. and also contributing to the rural economy to decrease their pressure on forests.

3.4. Cement Industry

In Turkey, construction sector is dominated by concrete for decades. Especially in big cities like Istanbul where constructing for mid-rise or high-rise is a requirement, the citizens and the constructors trust in concrete. Besides that the education is also supporting and teaching nothing more than concrete and steel. Since cement is the main material for concrete, this sector is also developed highly.

Last year the overall production of cement in the world increased 12% and reached the level of 2740 million tone. Asia is the biggest cement producer in the world and last year they had a 14,7% of increase rate on production[45].

44 Forestry Outlook Study for Turkey, Towards the 100th Anniversary of the Republic of Turkey

45 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

Cement industry in Turkey has started production at 1911 in Darıca. That year the production amount was 20,000t/year. After 1950, with the foundation of Turkish Cement Industry T.A.S (CISAN), the production increased but still the demand was higher than the production. That's why importing cement continued since late 1970's[46].

Right now the total amount of factories is 60 all over Turkey. 16 of these factories are foreign investment, 44 are domestic based. At the present cement industry of Turkey is in a very good shape in overall rankings in the world in both production and export. In Europe, Turkey is the 3rd country with the highest production rate and 1st country with the export rate[47].

Figure 34_TOKI Buildings in Istanbul

In last years the improvement in cement industry is related to the balance in economy of the country. Another reason is the lower interest rates in housing credits that banks offer. So that low-income social group can also effort housing. For this reason government based companies make big amounts of investments in big cities for constructing middle-high rise apartment blocks out of concrete. (TOKI – Housing Development Administration of Turkey)

46 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

47 Turkish Cement Sector in year 2006, www.maden.org.tr

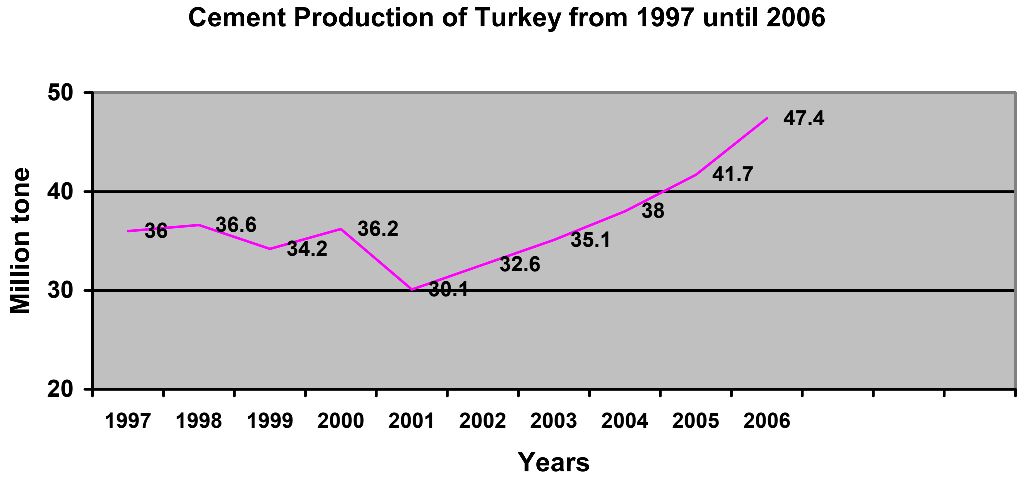


Figure 35_Turkish Cement Producers Association

According to the last report in 2006, cement production increased 11% and reached the level of 47,4 million tone, export rate decreased 27% in comparison to 2005. This change caused 19% increase of cement use in domestic market. For this demand the production has increased and export reduced 2million tons. In 2006 domestic consumption of cement was 43,3 million ton which also is equal to 600kg/person.

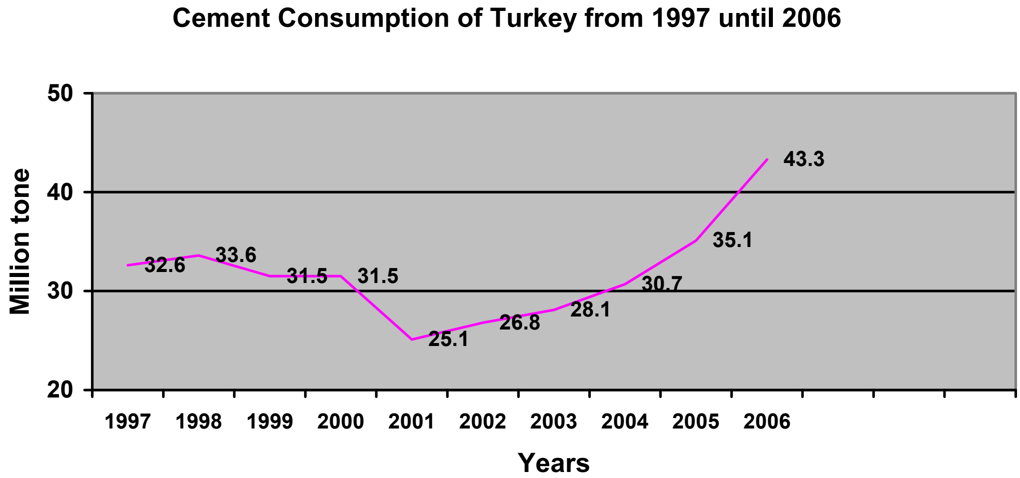


Figure 36_ Turkish Cement Producers Association

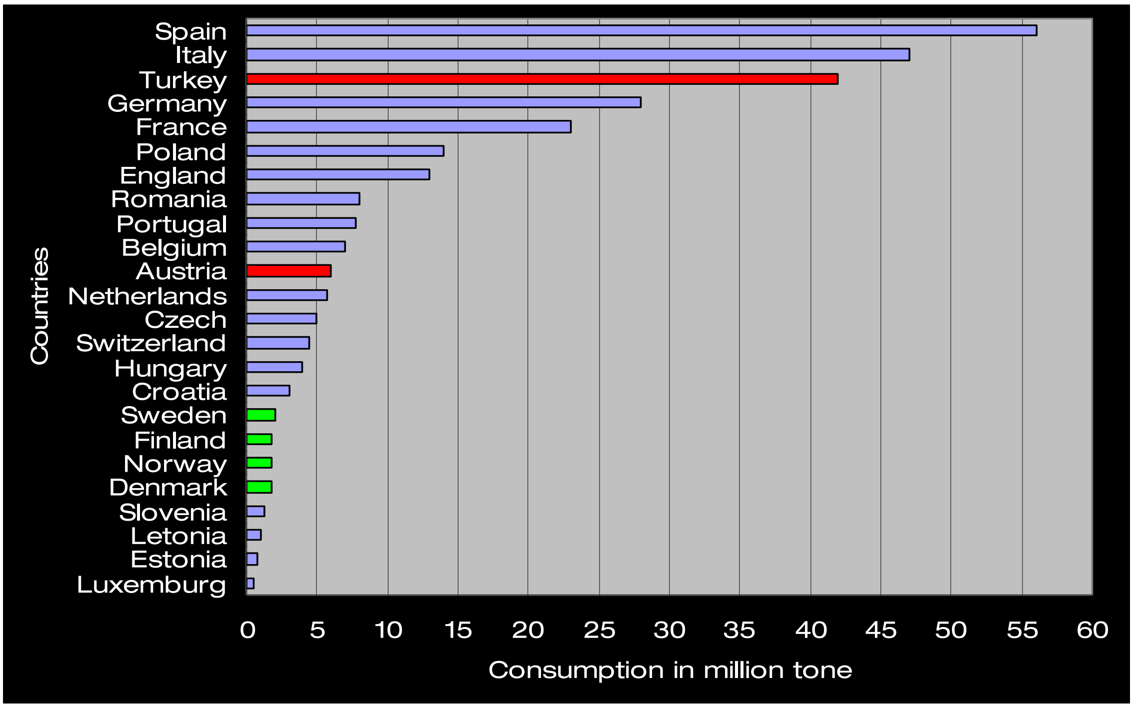


Figure 37_Cement consumption in the world

If we compare the prices of the cement in Turkey to the prices in EU with the context of production cost and productivity, still Turkey is working with higher electricity and fuel cost. However in EU countries the price for cement is average 60-90 euro/ton and in Turkey that price can stay lower.

The electricity cost is affecting 23% of total cost of cement. In Europe price is 0,052 euro / kWh while in Turkey that price is 0,065 euro / kWh. In 2006 the electricity consumption for cement production was 4,237,926,000 kWh in Turkey[48]. For producing 1 tone cement 110 kwh electricity is required.

Production Cost Percentages in Cement Sector for Turkey	Average Cost %
Raw Material	9,5
electricity	23,5
Fuel	20,0
Packing	7,5
Material	6,5
Workmanship	14
Output Services	10,0
Amortization	7,0
Other	2,0
Total	100,0

Figure 38_Factors Affecting Cement Cost

48 Turkish Cement Sector in year 2006, www.maden.org.tr

The fuel cost is affecting 20% and the factories use average quality of 5500Kcal/kg coal. In Turkey coal in that quality is not available. That's why the local coal is used with a mixture of steam-coal and petro-coke which are imported and those materials have an import limit. Government put regulations that don't allow companies to make stocks of these imported elements[49].

The most important problem for cement industry is the competitors from Asian countries. The prices are very low and these products are preferred in the market. But it is a big risk for a country where earthquake is a difficulty. For example in 1999 government has blocked cement import from Iran related to quality problems.

As a summary, in Turkey cement industry has the capacity, technology and productivity almost equal to EU standards but on the other hand the disadvantages on the lack of infrastructures for transportation (railways, harbors, etc.), general economical situation of the country, electricity and fuel cost creates differences.

In near future it's expected that in global market there will be a slow-down about cement demand and that will affect also Turkey. Besides if Turkey agrees to sign Kyoto Protocol there will be serious limitations about CO_2 emissions.

3.5. Steel Industry

Steel industry has a conjunction that goes parallel with the political and economical developments of the world. At the first half of 20th century the World War's and the political approaches had direct affect on steel industry. At the second half of that century there had been an increase on steel industry but in between there were also some slow downs because of economical or political crisis.

In Turkey, first steel factory was founded on 1939 in Karabük with the production capacity of 150,000 ton and followed with the second on 1965 in Ereğli with the production capacity of 470,000 ton and third one on 1977 in Iskenderun. Finally in 1980 steel production in Turkey has reached yearly capacity of 4.2 million ton[50].

49 Turkish Cement Sector in year 2006, www.maden.org.tr

50 Turkish Steel Sector Report 2008, Republic of Turkey, Head Office of Export

Right now that capacity is 25,8 million ton and there are 21 company on the market. Erdemir (Ereğli) is a company also running in the rankings of the world with the production capacity[51].

Rank	Company	Production (million tone)	
		2006	Rate
1	Arcelor Mittal	117,2	9,41%
2	Nippon Steel	32,7	2,63%
3	JFE	32	2,57%
4	POSCO	30,1	2,42%
5	Bao Steel	22,5	1,81%
6	US Steel	21,2	1,70%
7	Nucor	20,3	1,63%
8	Tangshan	19,1	1,53%
9	Corus Group	18,3	1,47%
10	Riva Group	18,2	1,46%
11	Severstal	17,5	1,41%
12	ThyssenKrupp	16,8	1,35%
13	Evraz Group	16,1	1,29%
14	Gerdau	15,6	1,25%
15	Anshan	15,3	1,23%
16	Jiangsu Shagang Group	14,6	1,17%
17	Wuhan	13,8	1,11%
18	Sumitomo	13,6	1,09%
19	SAIL	13,5	1,08%
20	Techint	12,8	1,03%
...	...	...	...
57	*Erdemir Grubu*	*5,0*	*% 0,4*
First 20 Companies Total Production		*481,2*	*38,7%*
World Production		*1.245*	*100%*

Figure 39_Steel Production Ranking in the World, Company Based

In 1970 all over the world, steel production was 595million ton and today this number is 1,343 million ton. China, Japan and USA are the biggest producers of steel and Turkey is 11th in the ranking with the yearly amount of 25,8million ton.

Year	World Production (million tone)
1970	595
1975	644
1980	717
1985	721
1990	775
1995	756
2000	848
2001	850
2002	904
2003	970
2004	1069
2005	1142
2006	1245
2007	1343

Figure 40_ World Steel Production

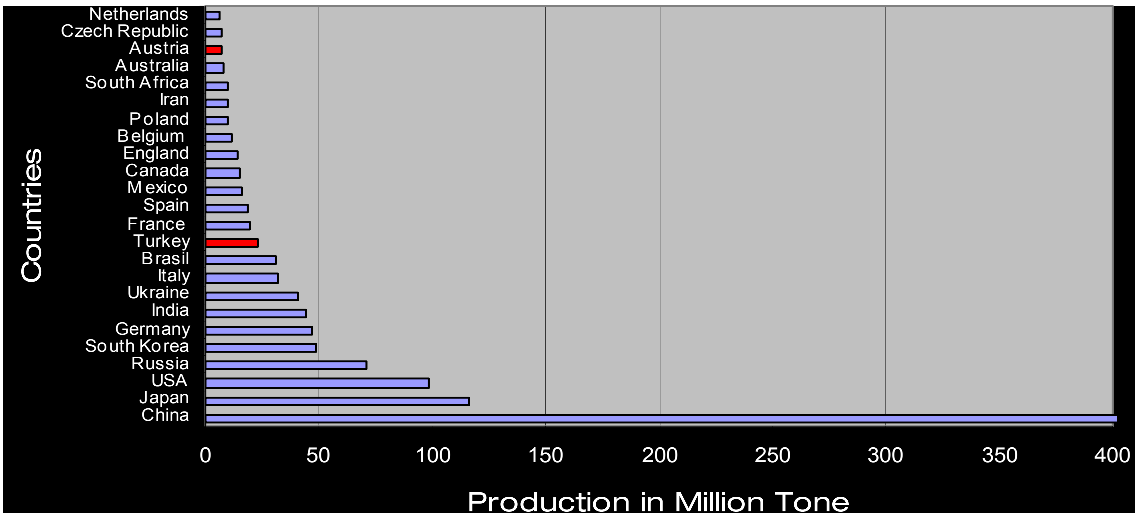


Figure 41_Steel Production of Countries

51 Turkish Steel Sector Report 2008, Republic of Turkey, Head Office of Export

Japan is the 1st country in export of steel with 32 million ton (%9 of the world). Turkey has 12,3 million ton. In import USA has 30,2 million ton, China 27,3 million ton and Turkey has 10,2 million ton in 11th place. In general, steel industry has 11,6% effect on the countries export rate[52].

Steel prices increased recently because of two new rules that have been set in sea transportation regulations. One of them is not allowing the ships older than 15 years old to some specific and important harbors, second is about environmental desires. In case of accidents, for reducing the risk of pollution, ships should be double skin construction. Because of these rules, in China there is a big demand for ship construction which has caused steel prices to increase.

Like in cement industry the infrastructure problems, imported raw material, high costs are the weaknesses. High demand in domestic market, high technology in production areas, high quality production, being neighbor to the developing markets such as middle-east, East Europe and Asia are the strong points. Demand increase all over the world, new arrangements by USA are the opportunities. Kyoto Protocol and ecology regulations, unstable prices are the threats.

52 Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, yem

3.6. Comments

There are some very sensitive barriers in the construction sector to increase wood use. Wood is not perceived to be durable and predictable. In terms of changing the national building code, the industry needs to build upon research completed elsewhere to support the case for using wood in mid-rise buildings.

Some workshops could be done. Those works could be presented to the Forestry Department of Industry Associations and making decisions about how the industry can capitalize on the opportunity and position itself in this evolving market. The necessity points are: building code revisions, market research and perception, sustainability and product and prefabrication development.

The constructors and contractors who are involved in building housing units have limited or even no knowledge of the use of wood products. They should be encouraged to learn more about using wood in construction by leading them to conferences or seminars. Like “proholz” in Austria, an online databank in Turkish should be done that they can reach according to their preference and curiosity.

In Turkey, construction sector is showing an increasing trend in last years. In matter of production, the developing technology in the industry is in a very qualified level due to EU norms. This positive situation should pass through to timber industry also.

In that chapter, the construction sectors in Turkey and their competitiveness in the global market is explained and numerical data is presented. Turkey is one of the strongest construction market competitors in the world with its land, labor power, capacity and working field alternatives. If that capacity could be used more sufficient and controlled what else could be done is the following question. For that reason a country like Austria in which timber market competitor firms like Wiehag, Kaufmann, KLH, Rubner Company, etc. exists, is chosen for making a comparison with Turkey.

If we should make a comparison between Austria and Turkey about forest industry production rates, a table like this would show up.

		AUSTRIA	TURKEY
land		83.000km2	783.000km2
Population / density		99/km2	91/km2
forest area	total area	38.860km2	212.000km2
	Per capita	0.04 km2	0.013
percentage		46%	12%
Wood production Wood consumption	Per capita	1.8 m3 1.6 m3	0.25 m3 0.32m3

Figure 42_Austria Turkey comparison per capita

Turkey is a country with 780.300km² land and 70.580.000 inhabitants. This makes almost 91people/km² but because of the big gap between city population and rural area population it is not possible to realize that.
On the other hand Austria is a country with 83.000km² land and 8.301.000 inhabitants almost 1/10 of Turkey. But the density is almost equal with 100people/km².

After that population and land comparison let's continue with timber productivity rates. Austria has 38.860km² forest land and this is 0,004km²/capita. In Turkey the forest area is almost 6 times more than Austria but this is normal when the land is 10 times bigger but the problem is with the productivity, because in Turkey productive forest area is 96.000km² and this makes 0,0013km²/capita. In last 40 years Austrian productive forest area increased 7% while this number is 4% in Turkey.

If the capacity and the resources would be used under control and efficient, there are no barriers in front of the timber sector to develop in Turkey. Due to the species that are growing in Turkey, production capacity, demand increase, technological development, labor power and production site availability, Turkey can be a leading country in global timber market.

4. CONTEMPORARY TIMBER ELEMENTS AND STRUCTURES, EXAMPLES FROM EUROPE

Timber based constructions show technical and architectural differences due to the system preferences. In Europe, wood based construction materials are used as a substitution to concrete or steel in an increasing demand rate. In this chapter there will be some examples from those projects and researches in Europe also including the explanation of some contemporary wood based products.

4.1. Contemporary Engineered Timber Products

- **Glue Laminated Timber**

Especially with the development of new solid wood products for timber engineering, usage of timber and its capacity has improved. Glued Laminated Timber (Glulam) is in market since early 20th century.

Figure 43_Spruce Goose, Glulam Production Plane_2 November 1947

Their uses are as hidden or exposed structural beams and columns in residential and commercial construction. Glulam timbers come in a variety of sizes with production based on volume basis.

Glulam has several advantages compared to solid sawn timbers. Glulam has the advantage that the products can be made much larger than the trees from which the lumbers were sawn. One of the other important advantages is that they can be made with lower grade lumber incorporated with higher stressed grade lumber to allow for custom structural requirements. Besides that, they can be designed to exhibit unique architectural effects.

Glulam is produced by at least three dried softwood boards or laminations glued together with the parallel to the grain[53]. First use of glulam was for arches and furniture design but during the World War 1, when it started to used in aircrafts, important improvements followed that process.

Figure 44_Glulam Production Process

The rapid development of the industry has also parallel effect to the development of adhesives. Earlier the laminations were made with casein glues which were moisture resistant instead of waterproof. The most important advantage of glulam is that they can be produced in any size or shape.

Figure 45_Glulam Column Example-StoraEnso Production

- **Cross Laminated Timber (CLT)**

CLT is a multilayered, completely and solidly made out of wood. Due to the gluing of longitudinal and transverse layers, the working of the wood is reduced to negligible degree and the standards of a modern building material are assured.

Figure 46_CLT element application example

This element is pre-fabricated and has the capacity to insulate heat and load bear. It can be used as ceiling, wall or roof element.

53 Herzog, Natterer, Schweitzer, Volz, Winter, Timber Construction Manual (2004)

- **Glulam Ceiling Elements**

They have tongue and groove profiles. So that it is a fast and trouble-free assembly as well as the accurate fit. The immediately loadable, structurally sound ceiling is the cost effective environmental alternative to conventional reinforced concrete ceilings[54].

Figure 47_Glulam Ceiling Element-Kaufmann Production

- **LVL(Laminated Veneer Lumber)**

It is produced by bonding together dried softwood veneers about 3mm thick. Mainly spruce and pine is the tree for this kind of production. They can be applied as beams, columns, diagonals, I-beams, load-bearing roof and floor decking. They have high strengths and favorable deformation behavior parallel to the grain, that's why highly suitable for more highly stressed parts of structures and for reinforcing load bearing timber components[55]

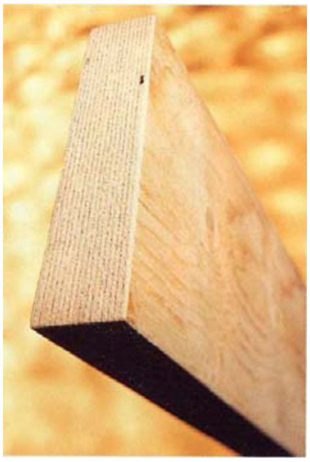


Figure 48_LVL Beam Example

- **I-Joists-LVL**

They comprise a timber flange, typically solid timber or LVL (laminated veneer lumber) and a panel product web, usually OSB (oriented strand board). They offer a number of benefits over traditional sawn joists, including low weight, no moisture movement and greatly reduced risk of squeaks.

Figure 49_LVL I-Joist Beams

54 http://www.kaufmann-holz.at/Profidecke.html

55 http://www.trada.co.uk/topics/engineeredwood/

- **Plywood**

It is produced also by multiple layers of veneers bonded together with adhesives. The veneers must be arranged symmetrically about the middle of the board and each with its grain at right angles to following layers for greater strength[56].

Figure 50_Plywood Example

It is also resistant to cracking, shrinkage and twisting in comparison to plain wood elements.

- **OSB**

It is an engineered panel product, produced by layering wood strands in specific orientations. Exterior layers are composed of strands aligned in the long panel direction while inner layers consist of cross or randomly aligned strands.

Figure 51_OSB Example

Under intense heat and pressure those strands become panels and are cut to size.. The combinations of the strands used are from 150mm long to 25mm wide[57].

- **MDF**

It is a type of hardboard, which is made from wood fibers glued under heat and pressure. It is denser than normal particle board, flat, stiff and easily machined. It is similar to plywood but made up of separated fibers and not wood veneers.

Figure 52_MDF Example

56 Herzog

57 http://www.osbguide.com/manufacturing.html

4.2. Examples from Europe

- ***Mühlweg Project (4-5 Storey), Austria***

The renewal in the building codes of Vienna on 2001, gave possibility to timber, in building construction as main structural element or in combination with other structural elements. These new legislations brought lots of new projects with including mid-rise social housings.

Figure 53_Mühlweg Project, Vienna

One of them is Mühlweg project, which is designed in Vienna after an architectural competition. The topic was to establish 3 different designs of mid-rise social housings with succeeding in passive-energy solutions. “Climate Protection Program of the City of Vienna “is the starter of this project and also encouraging the timber applications. Also support from a research association like HolzForschung Austria is an advantage for using engineered timber in housing. On 2006, the project was finished by 3 architectural offices and 3 developers from Austria;

Hermann Kaufmann with the support of BWS (Bau-Wohn und Siedlingsgenossenschaft) ,

Figure 54_Hermann Kaufmann

Hubert Riess with the support of ARWAG Bautraeger GesmbH

Figure 55_Hubert Riess

Dietrich Untertrifaller Architektur with the support of BAI (Bautraeger Austria Immobilien GmbH).

Figure 56_Dietrich Untertrifaller

- ***TF2000 (6 Storey), England***

This was a research project with collaboration of UK Government, BRE (Building Research Establishment), TRADA Technology Ltd and the UK timber industry. The aims for that project were to encourage timber market by demonstrating the benefits of timber frame construction and support its added value as a sustainable form of construction from a renewable material.

Figure 57_TF2000,England

Those aims have been achieved by testing and investigating a full-scale, 6 storey, timber frame building and producing authoritative guidance documents.

- ***Steinhausen (6 Storey), Switzerland***

Another project is from Switzerland with a design from architects Scheitlin_Syfrig+Partners. This project started to construction on 2005 and ended on 2006 and it is the first 6 storey housing building in Switzerland. The total cost was 7 million Swiss Frank (4.5 million Euro) and constructed from massive panel systems by Renggli AG construction company.

Figure 58_Steinhausen , Switzerland

- ***Progettosofie, Italian, (7 Storey), Shaking Table Test in Japan***

On 23rd of October 2007, this Italian design of 7 storey timber building exposed to a shaking table test in Kobe, Japan in a facility named E-Defense with a magnitude of 7.2 Richter and succeeded.

Figure 59_Progettosofie,Italy

For that construction it was used a little bit more than 250 m3 of wood and it was constructed with massive cross-laminated timber panel system.

- ***E-3 (7 Storey), Germany***

This project realized on 2007 in Germany, Berlin and it has 7 storeys out of timber. Static calculations and detailing was done by Prof. Julius Natterer. One of the distinctive feature about this building is it is in the city and in touch with other neighbor buildings. For urban use of timber this project is very important example.

Figure 60_E-3, Germany

The structural elements are again massive panel wall elements with combination of post and beam structure

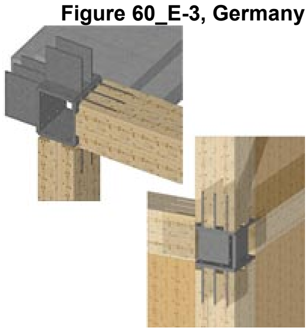


Figure 61_Joint of the columns and beams

- ***Project Limnologen, (8 Storey), Växjö, Sweden***

This project is the highest timber residential building project with its 8 floors that is constructed in Europe right now. City of Växjö has a very special place in Sweden. On year 1996, the city of Växjö chosen as a fossil fuel free city and the political consensus decided to reduce CO2 emissions 50% per capita between 1993 and 2010.

And they became successful with that by making the decisions, having strategies and achieving them, taking government support and financial support so that making researches in the University and applications in the city that brings some awards and public interest.

Figure 62_Växjö, Sweden

Also they choose timber as construction material. It was also forbidden to construct with wood almost 100 years in Sweden and they had a big loss of know-how, education, market, etc. Finally they decided to have a contemporary timber town where using timber as a construction material was a must.

And they chose Välle Broar as a research and practice area for timber constructions. It would be like an open-air building exhibition. Also the support from a foundation like CBBT (The Center for Timber Construction and Housing) should be considered as an important advantage for Swedish timber construction sector.

Figure 63_Construction Site of Limnologen

- ***Murray Grove (9 Storey), England***

This project is the highest residential timber building in Europe which is under construction. Architect Waugh Thisleton designed that building and it has 9 floors. Austrian timber production company which is specialized about so called KLH (Kreuzlagenholz-Cross Laminated Timber) panel elements is supporting the project. In that project approximately 1000m3 of KLH panels are going to be used. Even the staircases and elevator shafts are out of timber panels.

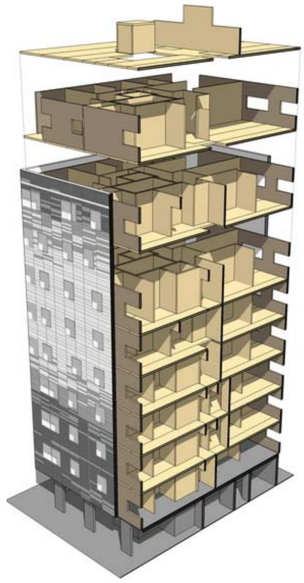


Figure 64_Murray Grove, England

- ***Scotia Place, (12 Storey), New Zealand***

This is a case study which was designed as a single storey basement which has wooden floors and structural steel framing as load bearing system. The design objective was to develop the most cost-effective structural system while meeting building functionality goals and adhering to code requirements. Also they compared concrete floor structural systems to wood floor systems in a way that results can argue about material cost and building functionality requirements.

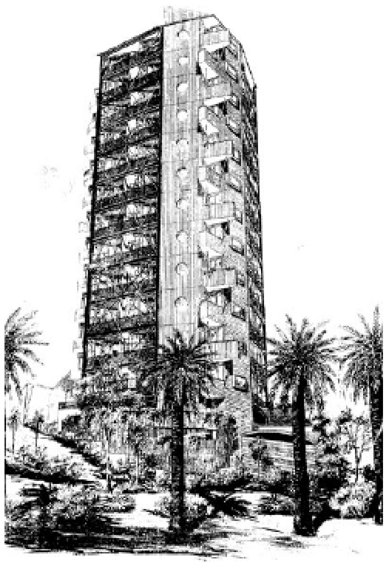


Figure 65_Scotia Place, Image, New Zealand

- ***Feasibility Study, (14 Storey), New Zealand***

In this study, timber and reinforced concrete structure is combined. According to the design, the reinforced concrete shear core takes all lateral and torsional loads while timber columns, beams and floor joists takes the gravity loads. Also the plywood diaphragm flooring transfers the lateral loads to the shear core. The columns and the beams could be fabricated from glue laminated timber or laminated veneer lumber.

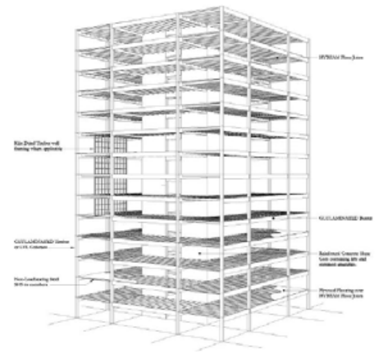


Figure 66_Feasibility Study from New Zealand

- ***8+, Research Study, (20 Storey), Austria***

This is a research study which is started on 2007 and going to be published on 2008 October. The goal of the study is to establish timber structure in urban area for showing its equal preferences as an alternative construction method. For that purpose a new type of urban high-rise timber construction for office use is designed.

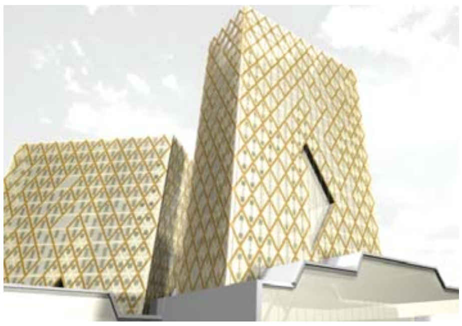


Figure 67_8+, Austria

5. CASE STUDY, ECONOMICAL APPROACH

5.1. Description

In this chapter of the work, aim is to compare the possible costs of a concrete and timber building in conditions of Turkey. In previous chapters, while explaining the history of wood based constructions in Turkey, the potential for the present and future intended to be put forward.

A 4 storey concrete building which has been constructed in Istanbul was selected as a case study subject. According to that case study that building is going to be transformed to a timber building and cost comparisons will be shown.

Figure 68_Existing Building in Istanbul

First of all the building is separated to its structural elements one by one and material analyses are done. According to the amounts of concrete structure the construction cost analysis are done (Case A). Afterwards second calculation was for the timber construction cost. The structural elements transformed to timber and a rough comparison has done considering two situations;

- Glulam production in Turkey (Case B)
- Glulam construction materials imported to Turkey (Case C)

For this cost calculations, Turkish price index for construction materials and a specific price list for wooden elements from WIEHAG GmbH is used.

5.2. Case A

- ***Structure***

The building has a structure with concrete columns, the ceiling is a kind of "bricket ceiling". The staircases and the elevator shafts are supported with concrete shear walls. In the façade, there is 20 cm thick brick layer and an aluminum-glass façade. The longest axis is 7,5 meters and the building is 42,1 meter long and 26,6 meters wide.

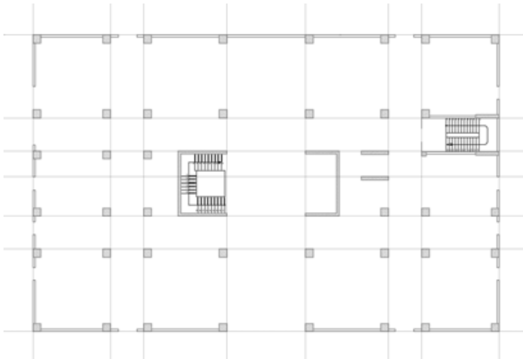


Figure 69_Floor Plan of the Existing Building

Building Elements

- **Columns**

70/70 reinforced concrete. In this building the consumption of concrete for columns per floor is calculated as 54,20 m3, and for reinforcement is 1,72 tone thin steel with dimension 8-12 mm and 2,58 tone thick steel with dimension 14-28 mm. The effect of the column construction cost to construction cost to of one floor is 7,6%.

Figure 70_columns in the Structural Plan

- **Ceiling**

30 cm thick bricket ceiling is realized in that building. For that construction type in 1m2, 7,95 kg steel and 0,087 m3 cement is used. Total amount per floor is; 174 m3 concrete, 13 tone reinforcement steel, and 7600 pieces of brickets. (1 bricket = 11,5kg). Ceiling is one of the most effective part of the construction to the cost. Therefore, it has a 35,5% effect.

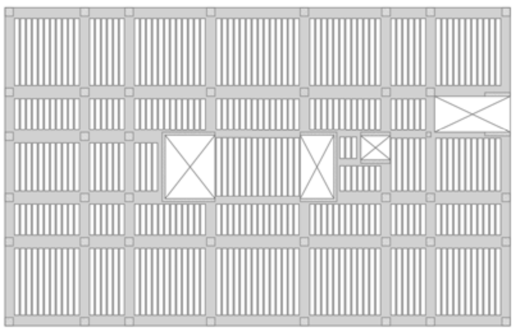


Figure 71_Ceiling Plan of the Existing Structure

Figure 72_Example of the ceiling during a construction

- **Shear Walls**

For staircases and elevators shafts concrete cores are supporting the structure. In one floor 23,74m3 concrete and 1,96 tone steel reinforcement was is used for that shear wall constructions. The effect of the shear walls to construction cost is 3,4 %

Figure 73_Shear Walls in the Structural Plan

Concrete Structure Whole Building Material Based	Ceilings	Columns	Shear Walls	Total	m³/m²
Concrete	1218	379.40	166.18	1763.58	0.22
Steel	11.69	3.86	1.75	17.30	0.002

Figure 74_Material Analyze

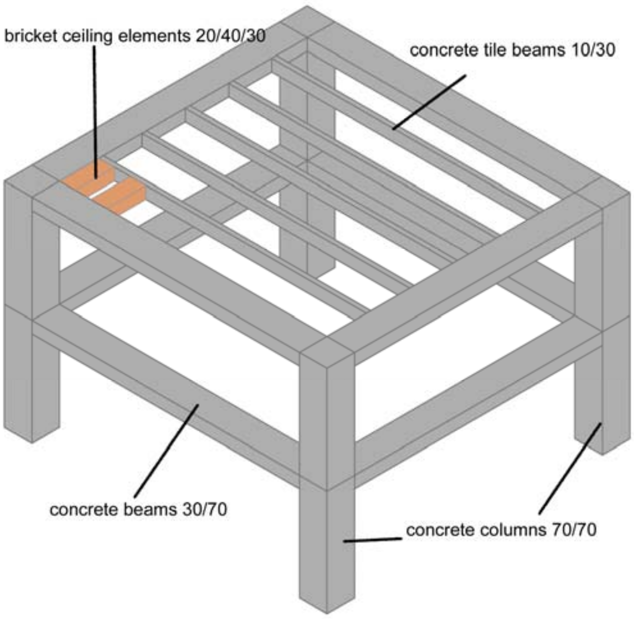


Figure 75_Concrete Structure Elements

Construction Cost of Concrete Structure

Concrete Construction in Turkey		Floor area (m2)	Floors	Preis (YTL)	Value	Amount/ Floor	Cost (YTL)	Cost / Floor (YTL)	Cost / m2 (YTL)	m3/m2	%	Total Cost / Floor (YTL)	Total Cost / m2 (YTL)	Total Cost / m2 (euro)
Column	Beton	1120	5	129.15	m3	54.20	6999.93	11,966	11	0.05	7.2%	165191	147	84
	Steel Reinforc. / 8-12			1155.00	t	1.72	1986.60							
	Steel Reinfor. / 14-28			1155.00	t	2.58	2979.90							
Shear Wall	Beton	1120	5	129.15	m3	23.74	3066.02	5,330	5	0.02	3.2%			
	Steel Reinfor. / 8-12			1155.00	t	0.78	900.90							
	Steel Reinfor. / 14-28			1155.00	t	1.18	1362.90							
Ceiling	Bricket Blocks 20x40x30 /	1120	5	0.75	piece	7600.00	5700.00	56,282	50	0.25	34.1%			
	Steel Reinforcement / thin			780.00	t	13.00	10140.00							
	Beton			129.15	m3	174.00	22472.10							
	cement screed 3cm			7.63	m2	1000.00	7630.00							
	plaster (labour included) 1cm			10.34	m2	1000.00	10340.00							
Framework	For Concrete Forming	1120	5	12.00	m2	1120.00	13440.00	20,160	18		12.2%			
	For Construction			6.00	m2	1120.00	6720.00							
Transport	Steel	1120	5	76.83	t	19.26	1479.75	10,950	10		6.6%			
	Bricket / Brick			34.91	t	171.26	5978.69							
	Beton			13.86	m3	251.94	3491.89							
Labour	For Beton + Steel	1120	5	16.00	m2	1120.00	17920.00	60,503	54		36.6%			
	For Bricket Ceiling			18.00	m2	1120.00	20160.00							
	Beton Pomping			89.00	m3	251.94	22422.66							

Figure 76_Concrete Construction Cost in Turkey
Source: www.birimfiyat.com

5.3. Case B

- ***Description***

In Case A the cost analyze of the existing concrete system was shown. In next two cases this building is going to be transformed to timber structure and the costs will be calculated. Case B is going to show the cost of timber building, if the production was done in Turkey with domestic material and labor. Case B includes glulam structural elements and that's why the results below are going to show estimated glulam production cost in Turkey.

- ***Estimated Glue Laminated Timber Production Cost in Turkey***

Type		2003		2004		2005		2006	
		YTL	$	YTL	$	YTL	$	YTL	$
Pine	m3	108	90.56	133	111.52	137	114.88	157	131.65
Spruce	m3	106	88.88	129	108.17	136	114.04	159	133.32
Beech	m3	155	129.97	133	111.52	133	111.52	143	119.91
Oak	m3	121	101.46	112	93.91	116	97.27	138	115.71

Figure 77_Log Prices in Turkey

1m3 glulam production cost / Turkey		value	price / $	price / YTL	amount	cost / $	cost / YTL
row material	log	m3	120	142.8	2	240	285.60
sawmill	sawmilling		10%	(-)	(-)	24	28.56
	drying		5%	(-)	(-)	12	14.28
	transport		5%	(-)	(-)	12	14.28
total price before the gluing process						288	342.72
glulam process	clean cut board	m3	(-)	(-)	1.2	345.6	411.26
	gluing	kg	2.68	3.2	8	21.44	25.51
	press		10%	(-)	(-)	34.56	41.13
	polish	m2	5.01	9.34	0.5	2.51	2.98
labour	labour	10%	15	17.85	(-)	34.56	41.13
end product / 1m3 glulam cost						436	520

Figure 78_Glulam Production Cost in Turkey
Source: www.birimfiyat.com

- ***Structure***

For this case, a post and beam timber structural system is chosen. The glued laminated columns, glued laminated primary beams and floor joists are supposed to resist the gravity loads and plywood flooring should transfer the lateral loads to the vertical elements. Beam-columns joints can be made fabricated steel plate connectors or bolts.

Building Elements

- ***Columns ;***

20/30 glulam production posts are used in this structure. Per floor 6,86m3 glulam consumption resulted for the columns. This has 3,75 % effect to the whole construction cost.

Figure 79_Glulam Column Element_StoraEnso Production

- ***Beams***

For primary beams, 20/40 and secondary beams, 16/40, glulam production is chosen. Per floor 33,98m3 glulam consumption resulted. This has a 18.5 % effect to the whole construction cost.

Figure 80_Glulam Beam Element_StoraEnso Production

- ***Ceiling-1***

I- joist LVL beams are used. 30 cm deep those beams are special production and per floor 320 pieces are used for supporting the ceiling element. OSB boards are laying on top of those joists. Total consumption is 232,16m3 and that has a 31,6% effect to the whole construction cost.

Figure 81_I joist Examples

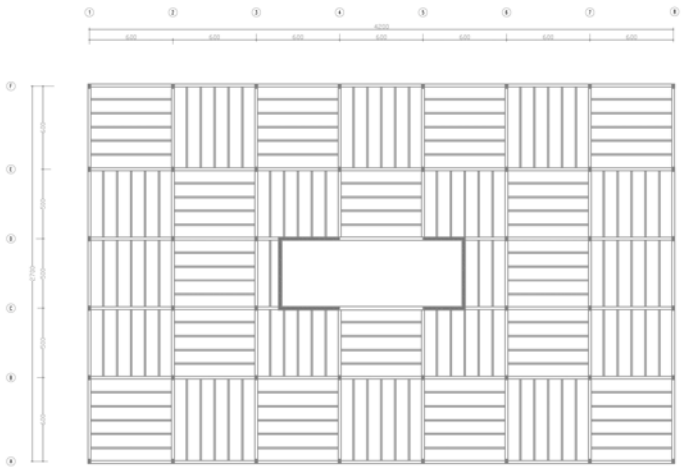


Figure 82_Ceiling Plan of Timber Structure

- ***Ceiling-2***

Sawn timber domestic production beams, 6/10, are used with OSB flooring for that second option. Per floor the amount of beams used is 6.9m3 and OSB is 220m3 and this has a 16,9% effect to the total construction cost.

Figure 83_Sawn Timber Beam Element

Timber Structure Whole Building Material Based	Ceiling	Columns	Total	m³/m²	kg/m²
Glulam	33.98	6.86	163.36	0.036	23.4
Sawn Timber	6.9		27.6	0.006	3.9
OSB	220		880	0.20	120

Figure 84_Material Analyze

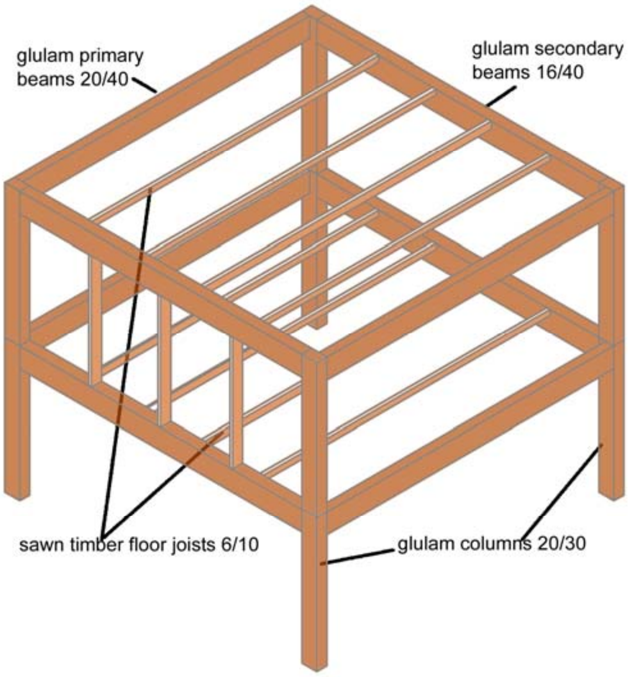


Figure 85_Timber Structure Elements

- ***Construction Cost of Timber Structure ; Production in Turkey (ceiling-1)***

Timber Construction in Turkey with Turkish production-Ceiling LVL		Floor / m2	Floors	Preis (YTL)	Value	Amount	Cost (YTL)	Cost / Floor (YTL)	Cost / m2 (YTL)	m3/m2	%	Total Cost / Floor (YTL)	Total Cost / m2 (YTL)	euro
Columns	20/30 Glued Laminated Timber	1120	4	520.00	m3	6.86	3567.20	3567	3	0.006	3.74%	95316	85	48
Beams	Primary Beams - 20/40	1120	4	520.00	m3	20.16	10483.20	17670	16	0.03	18.54%			
	Secondary Beams - 16/40			520.00	m3	13.82	7186.40							
Shear Wall	Beton	1120	4	129.15	m3	23.74	3066.02	4595	4	0.02	4.82%			
	Steel Reinforcement / 8-12			780.00	t	0.78	608.40							
	Steel Reinforcement / 14-28			780.00	t	1.18	920.40							
Ceiling	floor joists LVL	1120	4	60.00	piece	320.00	19200.00	30120	27	0.16	31.60%			
	OSB 20mm			9.75	m2	1120.00	10920.00							
Framework	For Concrete Forming	1120	4	12.00	m2	65.00	780.00	7500	7		7.87%			
	For Construction			6.00	m2	1120.00	6720.00							
Transport	Steel	1120	4	76.83	t	1.96	150.59	508	0.45		0.04%			
	Timber			14.32	t	2.00	28.64							
	Beton			13.86	m3	23.74	329.04							
Labour	Timber Work	1120	4	26.11	m2	1120.00	29243.20	31356	28		32.90%			
	Beton Pomping			89.00	m3	23.74	2112.86							

Figure 86_Timber Construction Cost with Domestic Production

- ***Construction Cost of Timber Structure ; Production in Turkey (ceiling-2)***

Timber Construction in Turkey with Turkish production - Ceiling Sawn Timber		Floor / m2	Floors	Preis (YTL)	Value	Amount	Cost (YTL)	Cost / Floor (YTL)	Cost / m2 (YTL)	m3/m2	%	Total Cost / Floor (YTL)	Total Cost / m2 (YTL)	euro
Columns	20/30 Glued Laminated Timber	1120	4	520.00	m3	6.86	3567.20	3567	3	0.006	4.55%	78476	70	40
Beams	Primary Beams - 20/40	1120	4	520.00	m3	20.16	10483.20	17670	16	0.03	22.52%			
	Secondary Beams - 16/40			520.00	m3	13.82	7186.40							
Shear Wall	Beton	1120	4	129.15	m3	23.74	3066.02	4595	4	0.02	5.86%			
	Steel Reinforcement / 8-12			780.00	t	0.78	608.40							
	Steel Reinforcement / 14-28			780.00	t	1.18	920.40							
Ceiling	Sawn Timber	1120	4	342.00	m3	6.90	2359.80	13280	12	0.16	16.92%			
	OSB 20mm			9.75	m2	1120.00	10920.00							
Framework	For Concrete Forming	1120	4	12.00	m2	65.00	780.00	7500	7		9.56%			
	For Construction			6.00	m2	1120.00	6720.00							
Transport	Steel	1120	4	76.83	t	1.96	150.59	508	0.45		0.04%			
	Timber			14.32	t	2.00	28.64							
	Beton			13.86	m3	23.74	329.04							
Labour	Timber Work	1120	4	26.11	m2	1120.00	29243.20	31356	28		39.96%			
	Beton Pomping			89.00	m3	23.74	2112.86							

Figure 87_Timber Construction Cost with Domestic Production

5.4. Case C

While Case B showed us the costs of a timber building which was constructed with local materials, Case C is going to present the possible cost of the same building but this time with imported construction material.

In that Case, the construction system and the materials used are completely the same, that's why they are not going to be shown second time.

- ***Imported Glulam Cost for Turkey***

1m3 glulam import cost		value	price / euro	price / YTL	amount	cost / euro	cost / YTL
row material	log	m3	115	202.4	2	230	404.8
sawmill	sawmilling		10%			23	40.48
	drying		5%			11.5	20.24
	transport		5%			11.5	20.24
total price before the gluing process						276	485.76
glulam process	clean cut board	m3			1.2	331.20	582.91
	gluing	kg	3.3		8	26.4	46.46
	press		10%			33.12	58.29
	polish	m3	2.39	4.21	2	4.78	8.41
labour	labour	15%	11.99	21.10		49.68	87.44
transport to Turkey	transport		10%			58.29	102.59
end product / 1m3 glulam cost						**503**	**886**

Figure 88_Glulam Import Cost

- ***Construction Cost of Timber Structure ; Imported Material (ceiling-1)***

Timber Construction in Turkey with imported material		Floor / m2	Floors	Preis (YTL)	Value	Amount	Cost (YTL)	Cost / Floor (YTL)	Cost / m2 (YTL)	m3/m2	%	Total Cost / Floor (YTL)	Total Cost / m2 (YTL)	euro
Columns	20/30 Glued Laminated Timber	1120	4	886.00	m3	7.13	6315.41	7999	7	0.01	5.9%	135971	121	69
	4/20 Planks			886.00	m3	1.90	1683.40							
Beams	Primary Beams - 20/40	1120	4	886.00	m3	20.16	17861.76	30106	27	0.03	22.1%			
	Secondary Beams - 16/40			886.00	m3	13.82	12244.52							
Shear Wall	Beton	1120	4	129.15	m3	23.74	3066.02	4595	4	0.02	3.4%			
	Steel Reinforcement / 8-12			780.00	t	0.78	608.40							
	Steel Reinforcement / 14-28			780.00	t	1.18	920.40							
Ceiling	Floor Joists LVL	1120	4	80.00	piece	320.00	25600.00	41280	37	0.16	30.4%			
	OSB			14.00	m2	1120.00	15680.00							
Framework	For Construction	1120	4	6.00	m2	1120.00	6720.00	6720	6		4.9%			
Transport	Timber	1120	4			20%		16028	14		11.8%			
	Steel			76.83	t	1.96	150.59							
Labour	Timber Work	1120	4	26.11	m2	1120.00	29243.20	29243	26		21.5%			
	Other													

Figure 89_Timber Construction Cost with Imported Material

- ***Construction Cost of Timber Structure ; Imported Material (ceiling-2)***

Timber Construction in Turkey with imported material		Floor / m2	Floors	Preis (YTL)	Value	Amount	Cost (YTL)	Cost / Floor (YTL)	Cost / m2 (YTL)	m3/m2	%	Total Cost / Floor (YTL)	Total Cost / m2 (YTL)	euro
Columns	20/30 Glued Laminated Timber	1120	4	886.00	m3	7.13	6315.41	7999	7	0.01	7.5%	106 579	95	54
	4/20 Planks			886.00	m3	1.90	1683.40							
Beams	Primary Beams - 20/40	1120	4	886.00	m3	20.16	17861.76	30106	27	0.03	28.2%			
	Secondary Beams - 16/40			886.00	m3	13.82	12244.52							
Shear Wall	Beton	1120	4	129.15	m3	23.74	3066.02	4595	4	0.02	4.3%			
	Steel Reinforcement / 8-12			780.00	t	0.78	608.40							
	Steel Reinforcement / 14-28			780.00	t	1.18	920.40							
Ceiling	Sawn Timber	1120	4	485.00	m3	6.90	3346.50	16787	15	0.16	15.8%			
	OSB			12.00	m2	1120.00	13440.00							
Framework	For Construction	1120	4	6.00	m2	1120.00	6720.00	6720	6		6.3%			
Transport	Timber	1120	4	20%				11129	10		10.4%			
	Steel			76.83	t	1.96	150.59							
Labour	Timber Work	1120	4	26.11	m2	1120.00	29243.20	29243	26		27.4%			
	Other													

Figure 90_Timber Construction Cost with Imported Material

6. RESULTS OF THE THESIS

Wood always has been a material that had to face questions and concerns about its fire resistance, durability against the time, causing loss of forests area, strength capacity, potential of multi-storey construction, being economic, etc. The answer is to find in the technology and developments, but also there are examples to find all around the world. Just for the ones who can look and see.

This chapter should consist of the results that have been collected during that research and studies. As it was mentioned at the beginning the aim of that thesis is to show the potential that a country already had for constructing with senses but lost it during the history. Those senses are related to wood based building materials. Here below some points that makes wood a better material than other construction materials will be explained. Also there may be some critics to the reasons why Turkey is not using timber anymore even they could.

- When Köprülü Sea Mansion in Istanbul was constructed on 17^{th} century, America, the country that Turkey is importing timber construction materials and systems, did not exist in history.

- In Europe building with timber is rising up but in Turkey the biggest wooden building in Europe is about to collapse because of decay and carelessness. (Orphanage in Princess Islands)

- Yes, wood burns, but the thing is, when it burns it is visible, not hidden. Action can be taken any second. Besides it holds longer than steel, and doesn’t collapse sooner.

- All over the world it is a well known scientific reality that forest areas can grow and get bigger or productive even the trees are harvested. Actually it is better for the forests to be harvested in a controlled way because the refreshment on the forest eco-system and surface would help to the ecological balance, since the younger trees absorb more CO_2 than the older ones.

- Wood is a recyclable construction material. Also wood is a living material and it keeps the CO2 in itself. Since global ecological situation is getting worst, as construction industry can also help to avoid that, starting with reducing the use of cement.

- Timber structures that were built 100 years ago might have problems due to weather conditions with isolation or heating and cooling or fire, but at the present with the help of developed technology and industry in timber, those disadvantages can be solved.

- With timber construction, if prefabrication is in a improved level, every single element is produced precisely and applied in the construction site with cranes or labor power in a very fast way. In traditional concrete buildings, the exterior walls are done by brick layer and the window holes are left empty for further PVC or other applications and even the window element is produced precisely in the factory, in the construction site, the quality of the work can not be high-level always and loss of energy, material and money affects the construction.

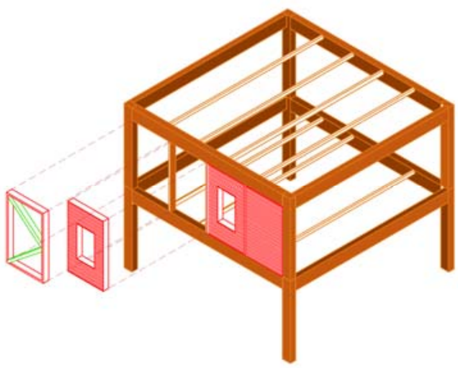


Figure 91_Timber Structure Facade Option

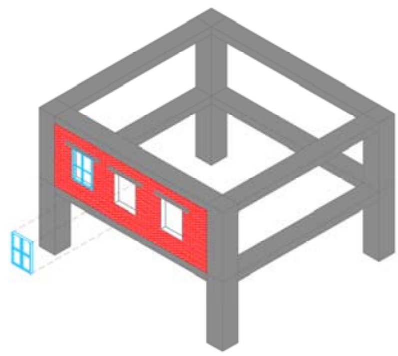


Figure 92_Concrete Structure Facade Option

- Timber is very flexible construction material and available in most of the regions of the world including Turkey. Use of wood helps to fight with ecological problems, it is a recyclable material, it helps to forestry and it brings new development to every part of the construction sectors.

- Timber structures are lighter because of their lightweight nature and this means a lower seismic load will be affecting to the building. Also the foundation can has smaller sizes than a concrete building.

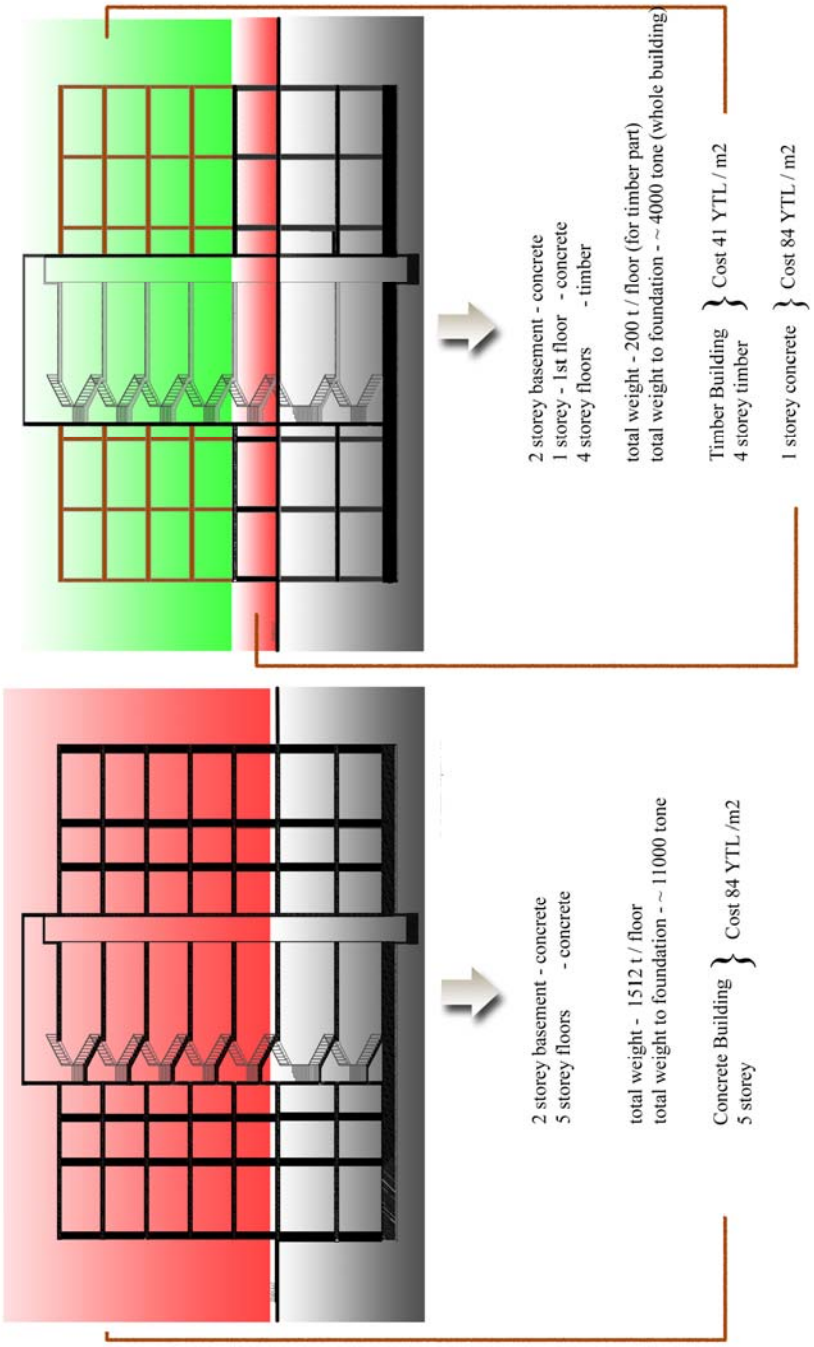


Figure 93_Comparison of Timber and Concrete Case Studies

- As steel reinforcing bars and concrete both require a large quantity of energy to make, the cost differential of these, relative alternatives, has recently become greater. In Turkey the labor cost is low but the material cost for wood is high. In Europe where the labor cost is high the material has lower price and since the labor is affecting the cost of the building 10% it is more rational to construct other materials.

- In most of the countries where they have seismic problems like Turkey, concrete constructions are avoided because of its greater seismic mass. This should enlighten us about using an alternative construction system such as timber.

- On the other hand, a global trend is developing especially the prices are having a trend to get global equalization (*). There are good business reasons for the constructors and developers to begin to build with timber in the long term especially for mid-rise building projects. If timber solutions are technically feasible and performances are comparable and prices are competitive in the market with other construction materials, there is no reason for not choosing timber.

- Making timber favorable again is the duty if people in the sector and the associations. It doesn't change by just building some houses out of timber. The sector should be united and use of wood should explain to community.

- European Union has some programs for supporting the developers and ideas. The countries which want to join to EU can get some kind of finance support for special development projects. One of those projects is realized in Turkey, Diyarbakir by Architect Çelik Erengezgin. He designed a "Sun-House" which uses just natural sources for heating and cooling. This project was supported by EU and construction started on April 2007. That kind of projects are pioneers for Turkey should encourage the developers. Since timber is a new and substitute construction material for Turkish construction market, for economic problems that kind of funds could be used.

- As education, industrial development, researches, seminars may help people to understand and realize things but when it comes to money, economical profit or loses defines most of the ideas and everything before, every effort is forgotten.

- Producing timber houses in Turkey is difficult right now due to lack of source and technology, besides professionals who could possibly work in that sector. That's one of the reasons why importing is more common.

- Three to five storey wood-framed buildings offer economical housing through fast construction and low economical costs. Besides investment return is fast due to construction speed and building use[58]

[58] Kevin C. K. Cheung, Ph.D. P.E. Western Wood Products Association, USA , Multi-story Wood Frame Construction

7. TABLE OF FIGURES

8. REFERENCES

- AREL A., (1982), Problems in Ottoman Housing Tradition Thorugh the History, EUGSF Yayinlari; p.70

- ARIN Süha, (1986) DVD, Documentary, When the Fog is Swept Away Ministry of Public Work and Settlements, 2000

- AVLAR E (2002) , Design of timber frame structures, YTU, Istanbul

- BOGAZICI University, Kandilli Observatory and Earthquake Research Institute

- Building Codes, Yapı Yönetmeliği, ,Ministry of Public Works and Settlements, Turkey

- DOGANGUN, Adem; Structural Systems in Timber Building in History; KTU, Trabzon

- FINKEL, Andrew: Wood culture and Timber Houses, http://www.turkishculture.org/pages.php?ChildID=278&ParentID=6&ID=27&ChildID1=278

- Forestry Outlook Study for Turkey (2007), Towards the 100th Anniversary of the Republic of Turkey, OGM

- GOKSAN, Serkan ; Wooden Houses-Wood Based Houses, www.serki.com

- GUCHAN, N. Sahin,(2005) Observations on Earthquake resistance of traditional timber framed houses in Turkey, Published Diploma Thesis, METU, Department of Architecture, Ankara, Turkey

- HERSEK, M. Can, (2001), Domestic Wooden Houses of Turkey, Naturopa, Trees Between Nature and Culture, European Council No: 96

- HERZOG, NATTERER, SCHWEITZER, VOLZ, WINTER, (2004) Timber Construction Manual

- http://www.safranboluevleri.net/varyasyon.asp

- http://www.turkishculture.org

- http://tr.wikipedia.org/wiki/%C4%B0stanbul

- http://www.istanbul.net.tr/istanbul_istanbul_nufus.asp

- http://www.osbguide.com/manufacturing.html

- http://www.kaufmann-holz.at/Profidecke.html

- http://www.trada.co.uk/topics/engineeredwood/

- http://www.statistik.at/web_de/statistiken/produktion_und_bauwesen/konjunkturdaten/baupreisindex/index.html

- www.birimfiyat.com

- KEVIN C. K. Cheung, Ph.D. P.E. Western Wood Products Association, USA , Multi-story Wood Frame Construction

- OZTIN F, (1994) 10 July1894 Istanbul Earthquake Report, 6,

- TOBRINER Stephen,(2000), Wooden Architecture and Earthquakes in Turkey: A Reconnaissance Report and Commentary on the performance of wooden structures in the Turkish earthquakes of 17th August and 12th November 1999, International Conference on the Seismis Performance of Traditional Buildings, Istanbul, Turkey, Nov 16-18

- Turkish Construction Sector Report, 2007,Turk Yapı Sektörü Raporu 2007, YEM

- Turkish Cement Sector in year 2006, www.maden.org.tr

- Turkish Steel Sector Report 2008, Republic of Turkey, Head Office of Export

- WALFORD Bryan, (2003) , NZ Timber Design Journal – Issue 2, Vol.12, Seminar at the Istanbul Technical University

- VARDAN Mkrtchyna, D.Arch.D.Trans., The 1988 Giumri earthquake : some thoughts and conclusions on the comparative performance of traditional and reinforced concrete buildings

APPENDICES

APPENDICES A

- **Plaster (2cm) – labor included**

BirimFiyat Türkiye | Türkiye'nin yapı maliyeti hesaplama sayfası | MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Demiryollar, Limanlar ve Hava Meydanları İnşaatı Genel Müdürlüğü (DLH)

Fasikül Demiryolu İnşaatı

Poz Bilgileri

Poz No 27.501/D

Tanımı 2 cm kalınlıkta beton yüzey sıvası

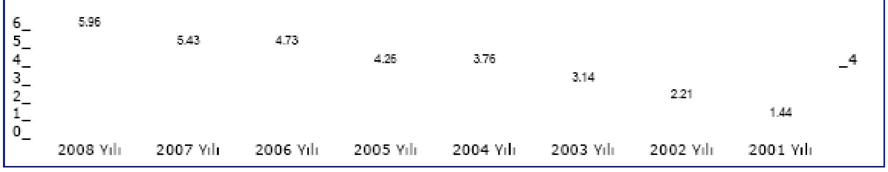
Birimi m²

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	5.96	0.00
2007	5.43	0.00
2006	4.73	0.00
2005	4.26	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	3.76	0.00
2003	3.14	0.00
2002	2.21	0.00
2001	1.44	0.00

Yıllara Göre Fiyat Grafiği



E-Posta

27.501/D Pozunun bilgilerini E-Posta adresime Gönder

İncelenen Kurum DLH

Poz No	Tanımı	Birimi
27.501/D	2 cm kalınlıkta beton yüzey sıvası	m²
27.583/D	2 cm kalınlıkta şap yapılması	m²
27.583/D-1	3 cm kalınlıkta şap yapılması	m²
27.586/D	4 cm kalınlıkta şap yapılması	m²
3000/D	İnşaat bünyesine giren çimento	Ton

- **Reinforcement Steel (08-12mm)**

BirimFiyat Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Demiryollar, Limanlar ve Hava Meydanları İnşaatı Genel Müdürlüğü (DLH)

Fasikül Demiryolu İnşaatı

Poz Bilgileri

Poz No 04.253

Tanımı İnce Nervürlü Çelik (08-12 mm)

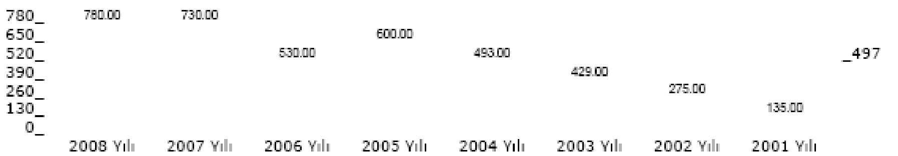
Birimi Ton

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	780.00	0.00
2007	730.00	0.00
2006	530.00	0.00
2005	600.00	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	493.00	0.00
2003	429.00	0.00
2002	275.00	0.00
2001	135.00	0.00

Yıllara Göre Fiyat Grafiği



E-Posta

04.253 Pozunun bilgilerini E-Posta adresime [ ] Gönder

İncelenen Kurum DLH

Poz No	Tanımı	Birimi
04.253	İnce Nervürlü Çelik (08-12 mm)	Ton
04.254	Kalın Nervürlü Çelik (014-26 mm)	Ton
04.255	Lamalar	Ton
04.256	Profil Demirleri (I,U,T,W)	Ton
04.256/2	Köşebentlar	Ton

- **Reinforcement Steel (14-26)**

BirimFiyat Türkiye | Türkiye'nin yapı maliyeti hesaplama sayfası | MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Demiryollar, Limanlar ve Hava Meydanları İnşaatı Genel Müdürlüğü (DLH)

Fasikül Demiryolu İnşaatı

Poz Bilgileri

Poz No 04.254

Tanımı Kalın Nervürlü Çelik (014-26 mm)

Birimi Ton

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	780.00	0.00
2007	530.00	0.00
2006	530.00	0.00
2005	600.00	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	493.00	0.00
2003	429.00	0.00
2002	275.00	0.00
2001	134.00	0.00

Yıllara Göre Fiyat Grafiği

	2008 Yılı	2007 Yılı	2006 Yılı	2005 Yılı	2004 Yılı	2003 Yılı	2002 Yılı	2001 Yılı
	780.00	530.00	530.00	600.00	493.00	429.00	275.00	134.00

780_ 650_ 520_ 390_ 260_ 130_ 0_ _471

E-Posta

04.254 Pozunun bilgilerini E-Posta adresime [ ] Gönder

İncelenen Kurum DLH

Poz No	Tanımı	Birimi
04.254	Kalın Nervürlü Çelik (014-26 mm)	Ton
04.255	Lamalar	Ton
04.256	Profil Demirleri (I,U,T,W)	Ton
04.256/2	Köşebentlar	Ton
04.258	Düz siyah sac (0.75 mm'lik)	Ton

- **Concrete**

BirimFiyat Türkiye

2008 yılı fiyatları ile hesaplamalar yapabilirsiniz
Yapı maliyetinize girecek miktarları verin gerisini düşün_
Dünyanın neresinde olu_

MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Demiryollar, Limanlar ve Hava Meydanları İnşaatı Genel Müdürlüğü (DLH)

Fasikül Liman ve Deniz İnşaatı

Poz Bilgileri

Poz No 16.023/2

Tanımı (A) Sınıfı B.A.betonu (granülometrik agrega ile) (350 doz)

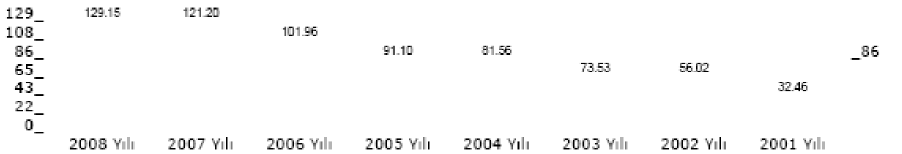
Birimi m³

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	129.15	0.00
2007	121.20	0.00
2006	101.96	0.00
2005	91.10	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	81.56	0.00
2003	73.53	0.00
2002	56.02	0.00
2001	32.46	0.00

Yıllara Göre Fiyat Grafiği



Analizi

Rayiç No	Tanımı	Birimi	Miktar
04.006/C	Kum (Tuvenan agregadan el ile elenmiş ve yıkanmış ve en az iki 'tane sınıfı' karıştırılarak hazırlanmış-08.004-)	m³	0.500000
04.003/C	Çakıl (Tuvenan agregadan el ile elenmiş, yıkanmış ve en az iki 'tane sınıfı' karıştırılarak hazırlanmış)	m³	0.700000
04.008	Portland çimentosu (torbalı)(TS 19,PÇ 325)	Ton	0.380000
04.031	Su -beton sulama suyu-	m³	0.150000
04.031	Su -beton sulama suyu-	m³	0.400000
03.524	Betoniyer'in 1 saatlik ücreti	Saat	0.250000
03.527	Vibratör'ün 1 saatlik ücreti	Saat	0.200000

- **Labor for Bricket Ceiling**

BirimFiyat Türkiye

MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum **Bayındırlık Bakanlığı**

Fasikül **İnşaat (Yapı İşleri)**

Poz Bilgileri

Poz No 18.095

Tanımı 30 cm yüksekliğinde asmolen döşeme tuğla blokları döşenmesi

Birimi m²

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	Lütfen Okuyunuz	MaliyetBul
2007	23.04	0.00
2006	20.09	0.00
2005	18.15	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	16.47	0.00
2003	14.31	0.00
2002	9.97	0.00
2001	6.58	0.00

Yıllara Göre Fiyat Grafiği

Yapım Şartları

1.05 m2 her boyutta ve yüksekliği h=.......... olan asmolen tuğla blokun (Poz. No:04.030) mevcut kalıbın üzerine projesine uygun olarak döşenmesi, inşaat yerindeki, yükleme, yatay ve düşey taşıma, boşaltma, her türlü malzeme ve zayiatı, işçilik, araç ve gereç giderleri, müteahhit karı ve genel giderler dahil 1 m2 asmolen döşeme tuğla blokları döşenmesi fiyatı:
ÖLÇÜ: Projesindeki boyutlar üzerinden hesaplanır.

Analizi

Rayiç No	Tanımı	Birimi	Miktar	Fiyatı	Tutar
	MALZEME				
04.024/1E	30x20x40 cm, Asmolen döşeme dolgu tuğla (TS 1261)	Adet	13.125000	0.66	8.66
	İŞÇİLİK				
01.013	Duvarcı ustası	Saat	1.300000	4.40	5.72
01.501	Düz işçi (inşaat işçisi)	Saat	1.300000	3.00	3.90
01.501	Düz işçi -işyerindeki yükleme, yatay ve düşey taşıma-	Saat	0.500000	3.00	1.50

- **Framework for Construction**

BirimFiyat Türkiye | Türkiye'nin yapı maliyeti hesaplama sayfası | MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Devlet Su İşleri (DSİ)

Fasikül Taşeron

Poz Bilgileri

Poz No 21.054

Tanımı Ahşap kalıp iskelesi (4 metreye kadar, 4m dahil)

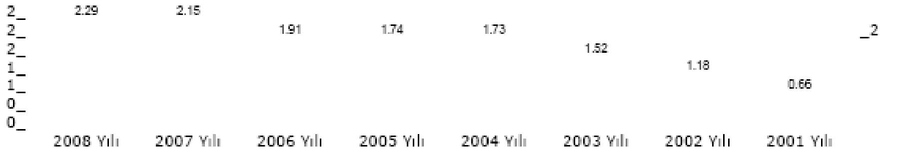
Birimi m³

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	2.29	0.00
2007	2.15	0.00
2006	1.91	0.00
2005	1.74	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	1.73	0.00
2003	1.52	0.00
2002	1.18	0.00
2001	0.66	0.00

Yıllara Göre Fiyat Grafiği



Yapım Şartları

İdarece lüzum görüldüğünde onaylanmış projesine göre yüksekliği bu poz kapsamına giren yapı ve sınai imalata ahşap taşıyıcı iskele yapılması sökülmesi, bu işler için gerekli her türlü malzeme ve kaybı, işçilik ve işyerindeki yükleme, yatay ve düşey taşıma, boşaltma müteahhit karı ve genel giderler dahil bir metreküp iskele boşluk hacmi fiyatı:
Ölçü : 1. Bu ölçüt kapsamına giren yapı ve sınai imalatın kalıp gören yüzü ile iskelenin isnat ettiği zemin arasındaki boşluk hesaplanır. Tavan meyilli olduğu takdirde ortalama yükseklik esas alınır.
2. Bu poz tünel ve galerilere uygulandığında galeri veya tünel kemerinin alt yüzeyi ile iskelenin isnat ettiği zemin arasındaki boşluk hesaplanır.
3. Bu ölçü kapsamına giren su deposu inşaatı iskelelerinde bu poz uygulanır. Bu takdirde beton su deposu tavanı ile iskelenin isnat ettiği zemin arasındaki boşluk hesaplanır.
4.Yapılarda betonarme saçak, balkon, beton betonarme istinat duvarları, perdeler ve benzeri imalatın kalıplarını, tutan, taşıyan üçgen şeklindeki iskele boşluk hacimleri hesaplanır. Üçgen yatay boyu kalıp yüksekliğinin yarısından fazla olmaza. Ancak bir metreden az yükseklikteki beton duvar, ters kirişler, genişliği 0.50 m.den az olan portafo ve saçaklar ve açıklığı 1.50 m. den az olan kapı pencere lentoları için iskele bedeli verilmez.
5. Özel kayar kalıpla yapılacak inşaat veya imalatın kalıp iskelesi için bu fiyat uygulanmaz.

- **Bricket Transportation**

BirimFiyat Türkiye | Türkiye'nin yapı maliyeti hesaplama sayfası | MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Bayındırlık Bakanlığı

Fasikül İnşaat (Yapı İşleri)

Poz Bilgileri

Poz No SNBF.04

Tanımı Delikli blok tuğla nakliyesi (İstanbul)

Birimi Ton

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	Lütfen Okuyunuz	MaliyetBul
2007	16.08	0.00
2006	14.36	0.00
2005	12.39	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	11.04	0.00
2003	7.05	0.00
2002	7.05	0.00
2001	4.43	0.00

Yıllara Göre Fiyat Grafiği

2007 Yılı	2006 Yılı	2005 Yılı	2004 Yılı	2003 Yılı	2002 Yılı	2001 Yılı
16.08	14.36	12.39	11.04	7.05	7.05	4.43

E-Posta

SNBF.04 Pozunun bilgilerini E-Posta adresime [ ] Gönder

İncelenen Kurum BAYINDIRLIK

Poz No	Tanımı	Birimi
SNBF.04	Delikli blok tuğla nakliyesi (İstanbul)	Ton
SNBF.05	Delikli blok tuğla nakliyesi (Tekirdağ)	Ton
SNBF.06	Delikli blok tuğla nakliyesi (Keşan)	Ton
SNBF.07	Düşey delikli izotuğla nakliyesi (Bartın)	m^3
SNBF.08	Düşey delikli izotuğla nakliyesi (Tekirdağ)	m^3

- **Steel Transportation**

BirimFiyat Türkiye — Türkiye'nin yapı maliyeti hesaplama sayfası — MaliyetBul Türkiye

Pozları Bana Gönder
Poz Kimin

Birim Fiyat'a Hoşgeldiniz
Bugün - 5 Eylül 2008

Kurumların Birim Fiyat, Analiz ve Yapım Şartları

Kurum Bayındırlık Bakanlığı

Fasikül İnşaat (Yapı İşleri)

Poz Bilgileri

Poz No SNBF.20/B

Tanımı Her çeşit betonarme ve profil demir nakliyesi (Rumeli yakasında)

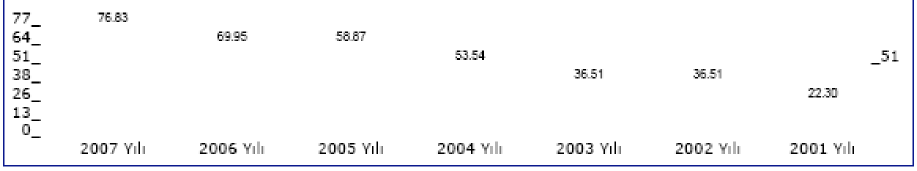
Birimi Ton

Birim Fiyatları

Yıllar	Birim Fiyatı	Montaj Bedeli
2008	Lütfen Okuyunuz	MaliyetBul
2007	76.83	0.00
2006	69.95	0.00
2005	58.87	0.00

Yıllar	Birim Fiyatı	Montaj Bedeli
2004	53.54	0.00
2003	36.51	0.00
2002	36.51	0.00
2001	22.30	0.00

Yıllara Göre Fiyat Grafiği



E-Posta

SNBF.20/B Pozunun bilgilerini E-Posta adresime [ ] Gönder

İncelenen Kurum BAYINDIRLIK

Poz No	Tanımı	Birimi
SNBF.20/B	Her çeşit betonarme ve profil demir nakliyesi (Rumeli yakasında)	Ton
SNBF.21/A	Her çeşit nervürlü çelik nakliyesi (İzmir) (Anadolu yakasında)	Ton
SNBF.21/B	Her çeşit nervürlü çelik nakliyesi (İzmir) (Rumeli yakasında)	Ton
SNBF.22/A	Her çeşit nervürlü çelik nakliyesi (İskenderun) (Anadolu yakasında)	Ton
SNBF.22/B	Her çeşit nervürlü çelik nakliyesi (İskenderun) (Rumeli yakasında)	Ton

APPENDICES B

- **Construction Price Index**

BAUPREISINDEX
Warenkorb für den Hochbau
Basis 2005 =100

Lfd. Nr.	Einheit	Bausparte / Leistungsgruppen und Einzelleistungen	Wohnhaus- und Siedlungsbau: Gruppen-	Einzel-	EL an Gesamt-	Sonstiger Hochbau: Gruppen-	Einzel-	EL an Gesamt-
			gewicht in %					
1. Erdarbeiten und Sicherung bei Erdarbeiten			4,23	100,00		6,33	100,00	
01	$1m^3$	Aushub der Baugrube		28,00	1,1846		22,59	1,4306
02	$1m^3$	Aushub von Gräben aller Art		17,00	0,7192		18,96	1,2004
03	$1m^3$	Liefern und einbringen einer Schicht aus Schüttungsmaterial		27,10	1,1465		23,52	1,4897
04	$1m^3$	Aushubmaterial oder Mutterboden fördern und abladen		27,90	1,1804		34,93	2,2121
2. Kanalisierungsarbeiten			0,88	100,00		1,15	100,00	
05	1m	Gerade Kanalrohre aus Kunststoff		49,46	0,4354		46,40	0,5317
06	1ST	FT Putzschächte/Sickerschächte aller Art aus Betonringen		50,54	0,4449		53,60	0,6141
3. Beton- und Stahlbetonarbeiten			26,73	100,00		24,62	100,00	
07	$1m^3$	Stahlbetonfundamentplatten		14,57	3,8954		12,78	3,1453
08	$1m^3$	Wände aus Beton		15,46	4,1332		11,36	2,7964
09	$1m^3$	Decken und Kragplatten aus Beton		15,97	4,2689		17,39	4,2824
10	$1m^2$	Stahlbetonelementdecken		9,48	2,5347			
11	$1m^2$	Schalung für Betonwand		20,26	5,4162		30,47	7,5007
12	1kg	Bewehrungsstahl für Bauteile aller Art		24,26	6,4835		28,00	6,8926
4. Mauer- und Versetzarbeiten			7,50	100,00		4,77	100,00	
13	$1m^2$	Mauerwerk ..... cm dick aus Hochlochziegeln (HLZ)		27,50	2,0632		20,91	0,9976
14	$1m^2$	Mantelbetonwände mit Mantelsteinen		36,60	2,7460		33,04	1,5765
15	$1m^2$	Zwischenwände mit keramischen Langloch-/Hochlochziegeln		14,60	1,0954		20,19	0,9634
16	$1m^2$	Zwischenwände mit zementgebundenen Hochlochsteinen		8,40	0,6302			
17	1ST	Zargen aus Stahlblech		12,90	0,9678		25,86	1,2341
5. Putzarbeiten			6,73	100,00		3,25	100,00	
18	$1m^2$	Innenputz auf Wänden		79,30	5,3330		76,92	2,4999
19	$1m^2$	Fassaden Oberputz auf Kalkzementbasis		20,70	1,3922		23,08	0,7501
6. Estricharbeiten			3,38	100,00		3,08	100,00	
20	$1m^2$	Trittschalldämmung mit Mineralwollenplatten		35,50	1,2011		31,90	0,9831
21	$1m^2$	Schwimmender Estrich als Unterlagsestrich		64,50	2,1824		68,10	2,0985
7. Abdichtungen			0,69	100,00		1,07	100,00	
22	$1m^2$	Waagrechte/lotrechte Abdichtung auf Unterböden/ Wandfl.		100,00	0,6876		100,00	1,0676
Baumeisterarbeiten			50,14			44,27		
8. Dachdecker- und Schwarzdeckerarbeiten			3,37	100,00				
8-1. Schwarzdeckerarbeiten						2,56	100,00	
23	$1m^2$	Wärmedämmschicht mit Platten aus EPS-W 30					58,32	1,4907
24	$1m^2$	Betondachsteindeckung		61,70	2,0787			
25	$1m^2$	Dachhaut		38,30	1,2903		41,68	1,0653
8-2. Dachdeckerarbeiten						0,70	100,00	
26	$1m^2$	Faserzementdachplattendeckung					100,00	0,6998
9. Bauspenglerarbeiten			1,58	100,00		1,48	100,00	
27	1m	Mauer- oder Brüstungsabdeckung					47,11	0,6977
28	1m	Saumblech/Saumstreifen/Giebeleinfassung		39,50	0,6230			
29	$1m^2$	Dachdeckung		60,50	0,9542		52,89	0,7833
10. Fliesen-, Platten- und Mosaikiegearbeiten			2,41	100,00		1,94	100,00	
30	$1m^2$	Wandbelag/Bodenbelag in Innenräumen		100,00	2,4127		100,00	1,9385
11. Natur- und Kunststeinarbeiten			1,04	100,00		2,13	100,00	
31	$1m^2$	Fußbodenbelag aus Natur-/Kunststein		46,05	0,4801		75,50	1,6119
32	1m	Gerade Innenstufen-tritt-/-setz-platte aus Natur-/Kunststein		53,95	0,5624		24,50	0,5230
12. Schlosserarbeiten			6,66	100,00		4,76	100,00	
33	1ST	Innentüre (Brandschutztür)		11,34	0,7553		62,24	2,9619
34	1m	Geländer (Stiegen, waagrecht, steigend) im Gebäude		69,82	4,6491		37,76	1,7969
35	1ST	Alutür ein-/zweiflügelig		18,84	1,2544			

13. Konstruktiver Stahlbau und Vorgehängte Fassade						4,47	100,00	
36	1kg	Konstruktion aus warmgewalzten Profilen		*)			46,57	2,1686
37	1m²	Pfosten-Riegelfassade		*)			51,43	2,2963
14. Zimmermeisterarbeiten			2,34	100,00		3,71	100,00	
38	1m²	Pult-, Sattel-, Walm-, Flachdachkonstruktion		43,60	1,0194		32,69	1,2141
39	1m²	Dachflächenschalung		56,40	1,3186		26,16	0,9715
40	1m²	Riegelwand, Zwischensäulen, Riegel und Streben		*)			41,15	1,5283
15. Tischlerarbeiten inkl. Holzfußböden			6,52	100,00		3,52	100,00	
41	1ST	Innentüre		80,50	5,2471		55,10	1,9372
42	1m²	Mosaikparkett (Klebeparkett)		19,50	1,2710		*)	
43	1ST	Decklage von Wand- und Deckenverkleidungen		*)			44,90	1,5786
16. Trockenbauarbeiten			2,02	100,00		4,60	100,00	
44	1m²	Metallständerwand mit einfachem/doppeltem Ständerwerk		100,00	2,0231		42,78	1,9685
45	1m²	Abgehängte Decke		*)			57,22	2,6329
17. Glaserarbeiten						0,24	100,00	
46	1m²	Normal/Spezial-Profilbauglas		*)			100,00	0,2393
18. Außenwand-Wärmedämmverbundsysteme (WDVS)			0,56	100,00		0,92	100,00	
47	1m²	WDVS ohne/mit Verdübelung		100,00	0,5615		100,00	0,9231
19. Beschichtungen auf Holz, Metall, Mwk, Putz u. Beton			1,86	100,00		1,44	100,00	
48	1m²	Deckende Beschichtung auf Stahl		21,50	0,3988		22,21	0,3207
49	1m²	Beschichtung mit Innendispersionsfarbe		47,50	0,8812		47,26	0,6826
50	1m²	Versiegeln der Betonoberfläche mit Polymerisatharzlack		31,00	0,5751		30,53	0,4409
20. Klebearbeiten für Boden- und Wandbeläge			1,11	100,00		1,25	100,00	
51	1m²	Bodenbelag aus Linoleum/PVC		100,00	1,1133		100,00	1,2508
21. Fenster und Fenstertüren			3,61	100,00		4,81	100,00	
52	1ST	Einfachfenster aus Kunststoff/Holz/Aluminium		100,00	3,6110		100,00	4,8063
22. Bewegliche Abschlüsse von Fenstern						0,55	100,00	
53	1ST	Außenjalousie mit flexiblen Lamellen		*)			100,00	0,5545
23. Zentralheizungen und Belüftungsanlagen			5,29	100,00		5,60	100,00	
54	1ST	Kessel- Brennanlagen		26,60	1,4068		11,52	0,6450
55	1ST	Elektro - Einbauheizung f. Warmw.		11,40	0,6029		*)	
56	1ST	Plattenheizkörper plan/profiliert aus Stahlblech		27,00	1,4279		20,96	1,1740
57	1m	Mittelschwere Gewinderohre aus Stahl		35,00	1,8510		23,39	1,3101
58	1m²	Rechteckige Luftleitungen aus verzinktem Stahl		*)			29,28	1,6394
59	1ST	Zul/Abl- Lüftungsgerät		*)			14,85	0,8317
24. Gas- und Wasserinstallationen			5,69	100,00		3,43	100,00	
60	1m	Gewinderohr, verzinkt, geschweißt		34,40	1,9572		21,11	0,7241
61	1m	Abflußrohr aus PE-HD/PP/PVC		21,13	1,2018		15,62	0,5358
62	1ST	Waschtisch mit/ohne Überlauf		44,47	2,5302		63,27	2,1703
25. Elektroinstallationen, Beleuchtungstechnik			4,97	100,00		6,42	100,00	
63	1ST	UP Verteilerkasten aus Stahlblech/Kunststoff		41,90	2,0844		25,10	1,6121
64	1ST	Mantelleitung		27,30	1,3581		36,57	2,3485
65	1ST	Steckdose mit Schutzkontakt		30,80	1,5322		18,07	1,1606
66	1ST	Ein-/Anbauleuchte mit .....x .....W Leuchtstofflampen		*)			20,26	1,3013
26. Personenaufzug			0,83	100,00		1,20	100,00	
67	1ST	Personenaufzug		100,00	0,8254		100,00	1,1971
Sonstige Bauarbeiten			49,86			55,73		

*) in der Bausparte als repräsentative Einzelleistung nicht vertreten

- **Cost for Glulam Production in Austria, Material Based by WIEHAG**

SUMMENERMITTLUNG		WIEHAG GmbH	WARENKORB
Angebotsnr.: K703710H5	Projekt:	Hochhaus Wien BSH - Bauteile	Preisbasis: 01.11.2007

Betriebsmittelnr.	*Betriebsmittelbezeichnung*	*Menge EH*	*Kosten/EH*	*Gesamtkosten*
LTAT1022025	AT-10 Wien 22 / 2,5 (STS)	100,0000 ST	930,0000	93.000,0195
LTAT1022035	AT-10 Wien 22 / 3,5 (Parze.)	5,0000 ST	1.100,0000	5.500,0000
LTAT1026040	AT-10 Wien 26 / 4,0 (Parze.)	1,0000 ST	1.400,0000	1.400,0000
LTAT1030040	AT-10 Wien 30 / 4,0 (Parze.)	1,0000 ST	1.620,0000	1.620,0000
LTAT1035045	AT-10 Wien 35 / 4,5 (Parze.)	36,0000 ST	1.700,0000	61.199,9998
LTZ	S U M M E Fuhrpark sub. - prop. Kosten	170.352,0193 EUR		
	Summe Löhne und Gehälter			7.557.335,74
	Material			
M1538	S U M M E ROHWARE	2.821,4985 m3		
M154611S	Rohware Sicht 46 mm Fichte	2.821,4985 m3	189,7000	535.238,2654
M1701M	Cascomin 1241 mit Härter 2542 (Mel.)	20.618,1444 kg	1,7025	35.102,3908
M1701RF	Dynosol S-204 fugenfüllender-Phenol Reso	3.063,4500 kg	4,1500	12.713,3175
M1800	S U M M E STAHLTEILE VERZINKT	322.831,0848 kg		
M1801310	Stahlteile verz. SGV 3 bis 1000 kg	308.700,0000 kg	3,8000	1.173.060,0000
M1801320	Stahlteile verz. SGV 3 von 1001 kg bis 2	8.400,0000 kg	3,5500	29.820,0000
M1803	Auflagerplatten verz. bis t= 10 mm	5.731,0848 kg	2,8000	16.047,0374
M1806S10	Aufz. Schrägbo. f. SGV u. SGE bis 1000 k	308.700,0000 kg	2,5000	771.750,0000
M1806S20	Aufz. Schrägbo. f. SGV u. SGE von 1001	8.400,0000 kg	1,8000	15.120,0000
M1901	Sonst. Lagermaterial Werk	149.700,0000 EUR	1,0000	149.700,0000
M19030824	STARDRIVE Holzbauschrauben 8.0 x 240	17.680,0000 ST	0,2353	4.160,1040
M19040824	SPAX-S Vollgewinde 8.0 x 240	16.155,4286 ST	0,4510	7.286,0983
M19041024	SPAX-S Vollgewinde 10.0 x 240	418.000,0000 ST	0,5550	231.990,0000
M19041040	SPAX-S Vollgewinde 10.0 x 400	377.160,0000 ST	1,2210	460.512,3600
M1913GV24	Stabdübel gv. M24	564,4800 m	6,9005	3.895,1942
M1914608	Ankernagel 6.0 x 80	1.646.400,0000 ST	0,0537	88.411,6800
M19293065	Calenberg S65 30 mm	46,3680 m2	300,5000	13.933,5840
M300101	Plastikfolie schwarz	17.271,7440 m2	0,1457	2.516,4931
M300202	AIDOL Imprägniergrund GN farblos	6.098,3429 l	2,1400	13.050,4537
M4208	Sonstige Platten	2.130.456,0000 EUR	1,0000	2.130.456,0000
M6501	Montagebus	42.868,1000 km	0,5400	23.148,7740
M904110S	S - Fertiglamelle 10/41	180,0000 m3		
M904114S	S - Fertiglamelle 14/41	427,0000 m3		
M904116S	S - Fertiglamelle 16/41	803,1680 m3		
M904120S	S - Fertiglamelle 20/41	748,8000 m3		
M905001	S u m m e BSH-FERTIG - Projekt	2.158,9680 m3		
M9060	S U M M E BSH-FERTIG - GESAMT	2.158,9680 m3		
	Summe Material			5.717.911,75

Projekt: U:\BS4\IHB\Projekte\Angebote\K703710H5 Hochhaus Wien — Seite: 2

KP / 09.11.2007 - 07:34 — Gedruckt mit AUER Success Version 4.50 - Lizenz 0128-00385