Timber Frame Residential Constructions In Turkey And Designing Model House

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Summary

Timber frame building systems have frequently been used in traditional Turkish architecture. According to the research on Turkish houses, timber frame construction has developed in the seventeenth century and been continuously used afterwards.

Starting with 1940s, modern technology has taken the upper hand in the construction industry of Turkey. Thanks to the development of transportation facilities and more widely available modern materials all around the country, like cement and industrial bricks, the construction of timber frame buildings have considerably declined. The changes in modern ways of building has resulted in the loss of knowledge about the tradition of timber building. The timber engineering is also not much strong in Turkey.

In order to improve and encourage timber building construction, there has been a study to find ou mock timber frame modular model houses that are congruent with the conditions in Turkey.

1. Traditional Turkish Timber Houses

The timber frame among the traditional construction systems has been used in all parts of Anatolia especially in Black Sea region. It has been faced to be forgotten due to the failure against alternatives structures technologies since 1900s. Today the age of the the timber houses which are available to use are about 80 and 150 years old. These house were constructed in a traditional system.

The traditional timber frame houses were made up of masonry basement (the ground, the cellar and occasionally half storey ) and upper floors with timber frame and timber hipped roofs. While the masonry was constructed with stones, the filling of the frame is with doub, rubble stone, unfired or fire brick. The frames of the houses were constituted with posts, studs, diagonal or X braces which were especially used for corners, beams and joist which forms the flooring. Diagonal or X braces were used to stabilize the panels [1]. The façade is formed in two different forms;

1. The roughest form
2. The rabbeted or the lap siding system

One of the prominent characteristics of the timber frame houses in Anatolia is not usage of the joint details in timber frame (except some settlements in The Black Sea Region) but the provision of it with nails. It is very well known that the usage of the nailed connections instead of the screws or joint connections, give rise to the flexion rate due to the nail’s flexible rate [2].
In Anatolian samples the joint connections are especially used in doors and windows but the nailed connections usage in frames is a product of a conscious choice and a very past dated tradition. *The usage of lathing technique in filling gives structures a chance of being lighter and flexible. The prop system nailed usage and lathing technique are the ones which enstrenthen endurance of the Anatlian houses against the earthquake* [3].

With these properties the Anatolian timber frame houses are different from than the European counterparts. While the loadbearing timber building elements in such countries as England, Norway and Germany are attached to each other with joint connections are only used in some architectural elements like doors, windows and ceilings in Anatolia.

The Anatolian houses are generally orieled or cantilevered in the first or the second floors. The cantilever length is 100cm or 150 cm. The anglebrace is used to endure the oriel and cantilever (Figure 1).

The lathing technique has been used where the climate conditions are very mild and the amount of timber is so much. The timber laths are pounded to inner and outer of the timber frame in lathing system according to the 2-3 cm distances with 3-4 cm with and 1-2 cm thickness.

The horizontal loads of the wall under such structures are resembled to drape walls in quality. In order for heat insulation, the wall gap limited with laths are either filled with pebbles or left empty. The wall later plastered with lime mortar. The plaster wire is applied on the wood so as to the plaster will stick to the laths.

*Fig 1 Oriel and Cantilever in Turkish House*

To the houses are entered from the huge double doors which go to the yard. In the ground floor exist the service place (kitchen, warehouse…) and the stair which goes to the upstairs exists. There are rooms in upstairs which go to the hall. The hall is square or rectangular place for both passage way and the place where poeple spend time together. In temperate regions the open halls and in the other places the closed halls are noticeable. The planning types of the house are not so different than each other.

1.1 Murat’s House - Bornova

It is a settelement building in the Bornova town of Izmir. It is made up of a stone cellar floor, combined construction (wood frame + rough walling), ground and first floors. There is a wooden roof on the first floor.

**The outer wall:** The cellar walls are built with rough walling in block system and they are approximately 75 cm. All of the outer walls of the ground floor and first floor built with combined construction technique. This technique is combined by the timber frame bound to each other from
inner side and from rough stone and brick materials from the outer side. The traditional post and beam technique has been performed on the inner walls and the average thickness is 17 cm. The nailed and joint connections are used together on the walls. In the main structure components such as studs and prop square cross-sectional nails have been used.

**Floors**: The first floor was made up of 6/24 cm main beams and joists are scattered among them. The outer surface of the joists were covered with wood board (Figure 2). The total flooring height is about 30 cm, and the storey height is 450 cm. On the ceilings of the building the latings are mixed with straw.

*Fig 2 View of floor detail in Murat House*

### 1.2 Prinko Place (Greek Orphanage) - Princess Island in Istanbul

Hristo hill Princess Island, a structure in Istanbul, was built as a hotel and a gambling house in Istanbul in 1898-1899 (Prinko Palace). But because of not being permitted to work as an enterprise during Abdülhamit II, it was donated to the Fener Greek Patriarchate.

The building which is closed in 1960s has been empty and uncared up to now. The architect of the building is Alexandre Vallauri. Today the deserted building which may fall down any moment is 102 m length and wooden. It was structured five floors including the ground floor. The floor number will be six if the side divisions are considered. Different fringes over each other characterize the structure itself. The west side of the structure is activated with the cantilevers enlarging through upwards from the beams section which comes from main part (Figure 3)

*Fig 3 View of the building façade*

### 2. Engineered Timber Frame Houses In Turkey Today

Wood material, which caused old Turkish architecture to build a very important part of the very important buildings in the sense of cultural heritage, has faced to lose its foremans and its century-long knowledge and the traditions of the vocational practises to be forgotten due to the gradual changes in the structure of field. As a consequence of this, the construction production and wooden
structure has been left and no research and improvement over the its contemporary usage has been done.

A few prejudices such as offering a number of possibilities in multi storey timber frame systems, the low resistance against fire, to be vulnerable to biologic deteriorations, the destruction of the forest due to the timber usage have prevented the timber usage in production of structure in Turkey. After 1970s corresponding to fast urbanizations reinforcement concrete systems has been regarded as the single alternative.

The earthquakes in 1999 has put on the agenda the prejudices of timber houses again after seeing that the timber houses has had no damage or slightly damaged. Yet after this date 1-2 storey timber houses have been constructed in Istanbul and in other big cities by some well-to-do people. Platform frame systems and log systems are used in these constructions. The application of mass housing, satellite town or collective dwelling has not started yet for the living of more family.

3. **Comparison Of Engineering And Traditional Timber Frame Houses**

- If looked in general senses there is not much differences in timber frame system. The main components in the traditional and engineered timber frame houses are post, stud, bottom and top rail, beam and joist. The materials, the dimensions of the materials and the connection components have differed in engineered timber frame houses.

- While engineered timber frame houses horizontal loads provide stability fort he wall and the floor deck, in traditional timber houses the props have undertaken this job. The wall and the flooring boards in terms of statics can be considered as the industrialized form of the traditional lathing application.

- While in the connection of the timber loadbearing elements metal connection components and nails are used, in the traditional timber frame houses nailed connections are used.

- According to the cantlever lenght, prop angle-brace in traditional timber frame houses are used, on the other hand in the engineered timber frame houses the cantilever is being carried out with additional joist(s).

- The whole amount of the timber materials that are used in traditional timber frame systems are solid timber products. The solid timber in engineered timber frame systems beside oriented strand board, laminated veneer lumber, and the other types like plywood are also used. With the help of the these material that are used in engineered timber systems the cross-section of the timber has become less.

- The squared cross-sectioned posts(12/12-16/16 …..cm) of the walls in traditional systems are scattered between 100-150 cm distance and in some places they are set up from the squaredcross-sectioned diagonals and rectangular cross-sectined diagonals (4/16-5/14…cm)

- In engineered timber frame systems, instead of this, the wall frame is being constructed the same cross-sectioned rectangular studs which are placed 30-60 cm distance.
In the traditional technique the distance of the wall posts is being filled with block materials like stone or brick or lathing technique is used. In engineered systems the polystyrene hard foam for insulation, mineral wool or glass wool placed between studs.

In traditional and engineered timber frame systems the flooring constitute the main joists (beams) and joists. In traditional systems the flooring is formed from rectangular cross-sectioned solid timber beams and joists (4/20-6/18…cm) and the upper side of it is covered with 2,5-3/15-25cm floor lumber. Yet again with the engineered timber frame houses instead of the common engineered materials or solid timber and floor deck like oriented strand board and plywood is used.

In traditional timber houses multi storey applications has started the same as with the engineered timber frame houses. There are three or four storey houses various places with the leadership of Istanbul. The storey height is 250-300cm in engineered timber frame houses. When the storey height (400-450cm) is considered in the traditional houses it is equivalent to the five or six storey timber frame houses done with engineered timber frame houses.

4. The Designing Model House

It is possible that to get more positive results with adjusting of industrial timber construction systems after a well-balanced analysis of traditional timber systems done in Turkey. In modelling this adjusting has been aimed.

It is aimed to create the suggested model and the timber board modular optinal house types. The platform frame systems has been prefered on account of resembling so much to the traditional timber construction systems. All of the external walls in the model are loadbearing. Some of the inner walls are loadbearing on both sides. The non-loadbearing internal walls are in the characteristic of seperation. The user has obtained the plan flexibility with the changing of the walls. With the help of the model the detached houses, line houses, apartments and block of houses can be arranged.

4.1 Building Components

It will gone on a design which providing flexibility of the plan convenient to his aim, not necessitating crane for assembling and forming standard component at the model. Module system has been put forward for standardization. For the necessity of module system, main dimension has been accepted and with this time of the dimensions component has been constituted. For this reason, main dimension has been accepted as module axis (Figure 4).

Due to this;

Module axis: Main dimension= 40 cm smallest component dimension

System axis: It is formed with the times of module axis and the axis built the module; for wall panel =120 cm, for joists = 40cm, for roof truss = 60cm
4.2 The Frame System

The loadbearing and non-load bearing wall panels made of solid baked timber with combining of 6/12cm stud, bottom and top plate. The height of the panels is 250cm. The panels have been placed with the distance at the stud of loadbearing wall panels (LWP) are 38 cm (Figure 5), at the non-load bearing wall panel 60cm.

Apart from main panel type; TDP-1A is organized as door panel. TDP-1B panel will be used room and kitchen window at the outside wall, TDP-1C panel will be used at bathroom window.

I-joists were used in model floors. Because except I-joists and solid timber there is yet no such plant to produce in Turkey. I-joists will take place on the loadbearing wall, its upper will be sheathed with 18 mm thickness mortise and tenon oriented strand board.

Fig 4 Module and system axis

Fig 5 Loadbearing wall panel

The roof has been designed as gable roof from timber roof trusses. The trusses will be placed on the external walls. The trusses will be sheathed with 1 cm oriented strand board.

While amasing the external wall panels a corner post of 12/12cm integraling the two components have been used. At least two bolts in the form of up and down to the corner post and panels will be
fasten. The usage of the corner post will also be useful to endurance of the walls which the earthquake causes against horizontal loads.

4.3 Single Storey Type 1 – “SS Type 1”

SS Type 1, it is formed square design with 120 cm system axles (n) 8n x 8n. This type is about 92m² with total field design.

At this plan, it is possible to change places of the non-loadbearing walls without any changing the places of the kitchen and bathroom. So, relating to SS Type 1, A and B subsettings are formed (Figure 6). It could constitute various residential shapes by using various of the sub-settings of type 1 together.

**Fig 6 Site plan SS Type 1A-1B**

4.4 Single Storey Type 2 “SS Type 2”

SS TYPE2 it is formed rectangular design with 120 cm system axles (n) 5n x 8n. This type is about 58 m² with total field design (Figure 7).

**Fig 7 Site plan house SS Type 2A-2B**

4.5 The Multi Storey Type 1 “MS Type 1”

It is adaptation of the design explained at the planning of singular floor dwelling to multi storey dwelling planning. The staircase well has been added to single storey (Figure 8). Type for the planning of multi storey dwelling. The staircase well is combined 120cm system axles (n) and 2n/5n dimensions.
5. Conclusions

The timber frame systems which is a part of our traditional architecture are not the constructions systems that we are foreign. However, it could not find enough practice field when compared to the other construction systems. In Turkey what we need is the provision of the rational usage of our traditional timber construction systems in our daily systems and the publicity and the prevalence of the new timber construction and housing systems. It is possible that to get better results after a sound analysis of traditional construction systems so as to adjust it to the engineered timber construction systems. The perform of it has been aimed at the suggested the model house.

6. References

