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AN INVESTIGATION OF CONSTRUCTION SYSTEMS OF VERNACULAR TIMBER STRUCTURES IN TURKEY

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A b s t r a c t

Vernacular construction systems that are used extensively in Anatolia for centuries were neglected with the development of modern construction systems. Vernacular timber structures constructed without any engineering assistance and connection to any regulation, built entirely with local materials, demonstrate knowledge and experience of craftsmen who built these structures about use of materials, earthquake and soil characteristics. Revealing the heritage of this mastership, that is almost forgotten for this knowledge was not transferred in written sources, will both enlighten the structure history and be a source of inspiration for modern construction systems.

Vernacular timber structures are generally described related to construction techniques of their outer walls. Basically, techniques to build timbers walls can be separated two parts: I) Block Timber Walls, II) Timber Framed Walls. Under these main tittles there are many sub-tittles which named different locally. By usage preference of main material (timber) or infill materials (stone, kerpiç, brick) makes differences on construction systems. In this paper, construction systems of these traditional timbers in Turkey will be introduced systematically.

Introduction

Wood is one of the oldest building materials conventionally used all over the world. Usage of wood could be observed constructing walls, floors and roofs; as piles for soil improvement and as timber lacing between masonry walls.

Timber construction systems that are used extensively in Anatolia continued to build until the first half of 20th century. Vernacular timber houses constructed without any engineering assistance and connection to any regulation, built entirely with local materials, demonstrate knowledge and experience of craftsmen who built these structures about use of materials, earthquake and soil characteristics.

In relations between the master and the owner of the goods prior to the construction of traditional wooden structure design requirements, both material and systematic structural system selection, rational solutions and is manufactured in accordance with reality.

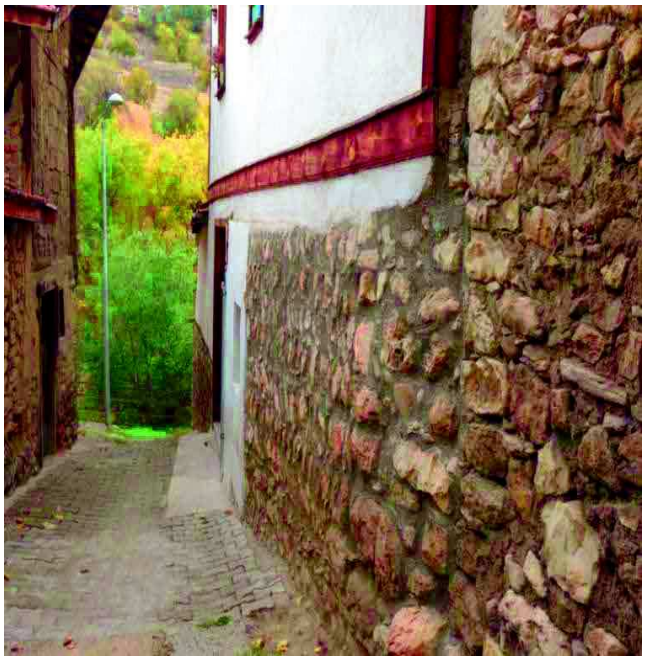
Fig. 1. Timber Houses in Safranbolu

Source: own research

Foundations

Foundations of the traditional Turkish house were constructed as masonry brick wall in a continuous form (Fig 2) or independent stones under the posts (Fig 3), depending on ground conditions. Bearing capacity of swampy and soft grounds was improved by nailing wooden piles to soil.

Fig. 2. Foundation Beneath Wall



Source: own research

Fig. 3. Independent Stone Foundation

Source: Gorun ARUN [2]

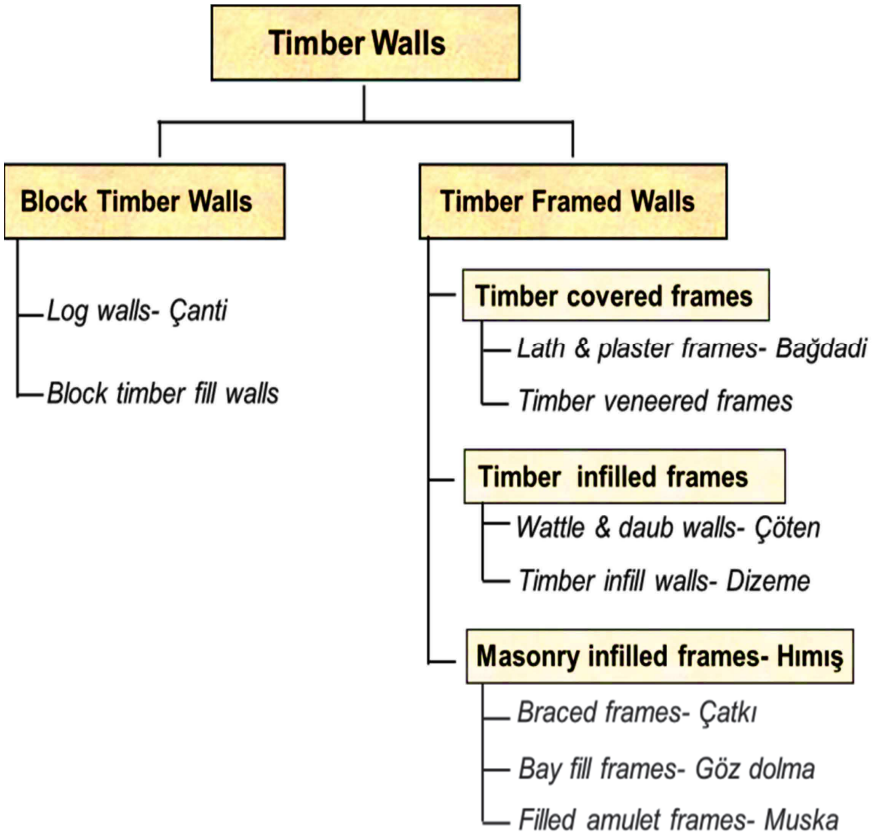
If the ground floor walls are the timber framed, to protect the regions that touching to soil directly from rain water effects, the foundation wall is arised to a subbasement level. In abundant rainy regions, this subbasement level creates the wall of ground floor as entirely masonry.

Depth of foundation changes between 0.50 – 1,00 meters depending on soil properties and how many floors the house is. Width of the foundation wall are about 0,50 – 0,70 meters depending on ground floor's construction system is timber frame or masonry.

Timber Walls

Classification of vernacular wooden structure made according to the outer walls of the constructing system. It is seen in the Fig. 4 timber walls can be basically separated two groups by type of use of the timber.

Fig. 4. Classification of Vernacular Timber Walls



Source: Gorun ARUN [3]

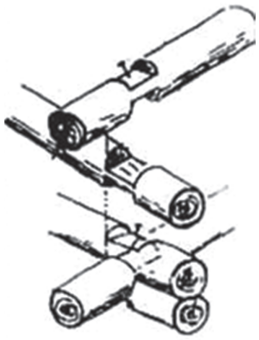
Block timber walls can be surveyed in two categories as Log Walls, aka Çantı, and as timber fill walls, aka Taraba.

Log Walls (Çantı): Exterior and partition walls of this type are constructed with rough round logs or solid sawn lumber that laid horizontally one over the other and anchored at the ends with simple cross lap (Fig. 5&6). The width/height ratio of solid sawn lumber is between 1/4 -1/3. The window openings are of 3 or 4 panes.

Fig. 5. Samples of Log Houses from North Anatolia

Source: Başkan, S.,(2008). "Geleneksel Doğu Karadeniz Evleri", Erdem Dergisi, 52.

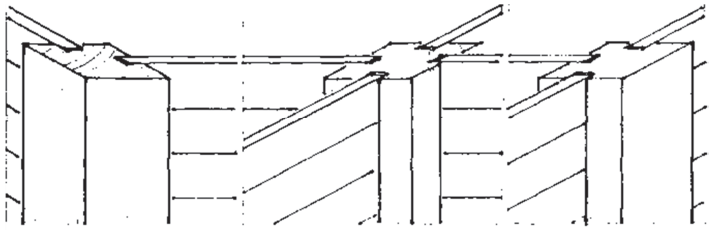
Fig. 6. Crossing Detail of Log Walls



Source: Sümerkan, (1990) [4]

Block Timber Fill Walls (Taraba): Wood columns are placed on the intersection point with the corners and the partition wall. Studs are placed to the sides of the door and window openings. The connection of the timber fills to the columns or studs is by passing the tongue at the ends of the horizontally laid timber through the grove in the columns. The horizontal timbers laid one over the other is connected to each other by tongue and grove joint in order to avoid rain water penetrating inside. Connection of the partition wall of horizontally laid solid sawn timber to the columns is by passing timber itself through the vertical grove of the column. The width/height ratio of solid sawn lumber of partition wall is 1/4 (Fig 7&8).

Fig. 7. Opening Grooves at Columns



Source: Sümerkan, (1990)

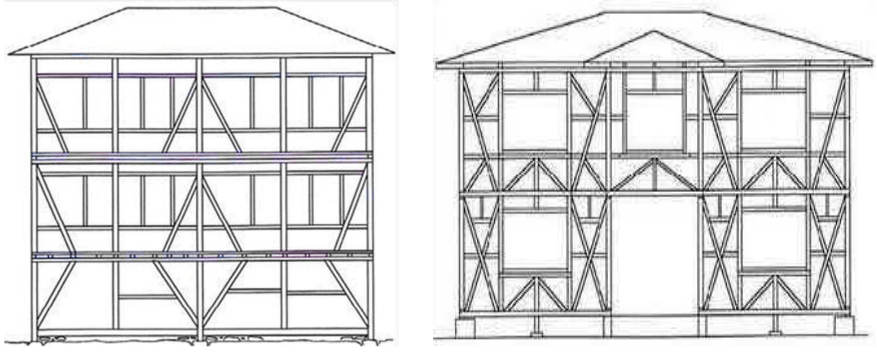
Fig. 8. Block Timber Infill Wall Sample

Source: Gorun ARUN

Timber framed walls are composed of columns or studs placed 0.60 - 1.50m apart resting on the lower chord beam and tied with the upper chord beam at each floor level. The structural composition of the wall between the studs and columns and upper and lower chords are of wide ranging structural typologies depending on the ability of the carpenter and availability of building materials. The framed timber walls can be classified as totally timber framed and composite with masonry infill.

Çatkı: According to the placing of studs in between the columns at the corners and intersecting walls, the structural system of this type can be classified as system containing bracing elements and no bracing elements.

Fig. 9. Horizontal, Vertical and Diagonal Elements of Çatkı



Source: Own Research

Fig. 10. Establishment of timber frame, Osmaneli

Source: Own Research

Hımış: if the empty areas in walls of timber frame are filled with stone, adobe or brick infill, these houses are called hımış. This system may be considered as stone masonry reinforced with timber. Hımış style houses generally rested on a heavy stone first floor wall. Depending on the available material and carpenter's ability, such hybrid timber framed walls of wide ranging typology are composed by either 25-60 cm spaced columns / studs or 60-150 cm spaced columns with horizontal and diagonal bracings.

Fig. 11. Hımış Wall Sample, Safranbolu

Source: Own Research

Conclusion

The most recent earthquake in Turkey, wooden structures has shown that adequate safety and well behaved during the earthquake. Traditional wooden buildings that have frequently arranged pillars, joists and roof rafters with many providing the level of security while maintaining the integrity of the load during an earthquake by many load transfering paths are statically indeterminate. The cracking of masonry blocks and plaster falling off a wooden frame, with no structural damage are fading of earthquake energy.

Traditional wooden buildings in Turkey, has been neglected and repaired constantly changed with different materials and techniques. Today's wooden architectural heritage has to be protected. In order to examination of these structures in accordance, working together of trained architects and engineers is essential to get structural analysis, for repairs and maintenance. On the other hand, it is necessary to raise awareness of community.

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