

# Observations on earthquake resistance of traditional timber-framed houses in Turkey

N. Şahin Güçhan\*

*METU, Department of Architecture, Graduate Program in Restoration, 06531 Ankara, Turkey*

Received 16 February 2004; received in revised form 16 August 2005; accepted 27 September 2005

## Abstract

The aim of this study is to establish the earthquake behaviour of traditional timber-framed houses in Turkey and their technical features to serve as a guide in their conservation. This paper first discusses the destructive effects of changing settlement patterns on the traditional building stock and explores earthquake damage on traditional Turkish buildings, analysing the 1894-İstanbul, 1970-Gediz and finally 1999-Kocaeli earthquakes. A short definition is then provided of timber-framed building methods in Anatolia, and the earthquake damages occurring in them are given. The following section briefly discusses the earthquake behaviour of timber-framed constructions in different countries. The paper concludes with the interpretation of features that increase the earthquake resistance of timber-framed buildings, which are related to the selection of land and the use of the lath and plaster technique, timber lintels, braces and nails.

© 2005 Elsevier Ltd. All rights reserved.

*Keywords:* Turkey; Earthquake; Traditional houses; Timber; Timber-framed houses; Construction technique

## 1. Introduction

### *1.1. Changing settlement strategies and their implications for the urban fabric*

Anatolian cities, showing typical characteristics of the pre-industrialized Ottoman cityscape, were subjected to extensive transformations due to rapid urbanization and modernization processes which took place after the establishment of the Turkish Republic in 1923. Preservation and planning activities were gradually developed and redefined to control and direct this unexpected change until the 1940s. However, it was only after 1951, when another wave of modernization due to the mechanization of agriculture in the rural areas had pushed people out of villages and into the urban areas, that preservation and planning activities became parallel processes by new preservation laws put into action and the establishment of new institutions related to such laws.

Again, efforts made for the sake of “modernizing” the cities due to this internal migration resulted in the gradual loss and replacement of the old urban fabric. New traffic arteries were opened in the traditional sectors creating new development areas along their stretches. Hence, by the end of the 1960s, the abandoned traditional sectors of the cities became squatter areas and led to loss of public interest in such areas and in related types of architecture—mainly timber-framed construction.

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. Beginning in 1973, with the legalization of the concept of “conservation area”, building rights were restricted within the boundaries of the registered “urban conservation sites”. This resulted in the practical freezing of construction activity and a decrease in land values at these sites and their gradual transformation into shelters for low-income groups [1].

After 1980, parallel to the neo-liberal transformations that occurred in the political system, some fundamental

\*Tel.: +90 312 210 22 02; fax: +90 312 210 11 08.

E-mail address: [neriman@arch.metu.edu.tr](mailto:neriman@arch.metu.edu.tr).

changes were brought about in the national planning activities. These changes were decision making at a local scale rather than centrally, making partial plans rather than total plans, and populist planning strategies rather than constructing strategies for the future. This strategy dealt a major blow to the efforts of establishing an integral planning understanding in a modernist approach, which was in the process of developing until that period. Tekeli [2] defines the situation in Turkey after 1980 as a period when “city planning, as a modernity project had withdrawn from the stage” and states that, “the actual city plans had become a collage of partial plans instead of being a single organic entity”. In the period after 1980, when the cities once again began to have a high immigrant population and populist policies began to reign, the cities began to lose their local characteristics. Historic parts of the cities and vernacular structures of the urban areas were once again transformed into environments consisting of building masses with deficient infrastructure created by the speculative demands of various interest groups.

Parallel to these transformations taking place in the planning field, certain construction techniques, that were apparently considered “modern”, began to be favoured extensively. Especially after the 1960s, the concrete frame system was accepted as the sole option and was used abundantly throughout the entire country. By using this system of construction, the cities were subjected to widespread building activity, including the newly introduced trend of constructing summerhouses in the coastal regions. As a consequence of such trends in the above-mentioned settlement strategies and related urban construction techniques, the traditional timber-framed houses, which prevailed for 300 years in Anatolia, were gradually abandoned and almost completely forgotten.

### 1.2. Re-thinking timber-framed construction as an alternative for the future

The earthquakes of 1999 brought into discussion the importance of the selection, production and usage of construction techniques as the buildings affected by the earthquake were mostly built with concrete frame systems. As a consequence of these discussions, the timber and steel frame-building systems, used widely in earthquake-prone areas in developed countries, were introduced into the building market and adopted mostly by higher income groups.

These developments also brought into consideration the conservation and reutilization of timber-framed houses, which form 80% of the total number of houses registered as cultural objects in Turkey. The recent and rising trust of the public in new timber-framed structures due to the consequences of earthquakes should also be oriented to the conservation of traditional buildings. This approach will make a considerable contribution towards the protection of Turkey’s cultural heritage. In order to achieve this

purpose, the measures developed in the timber-framed building tradition against earthquakes should be well understood.

“Traditional timber-framed houses”, which form the bulk of the historic urban fabric in Turkey, were brought into these discussions due to their earthquake-resistant properties as well as their cultural value. Research carried out thus far on traditional houses in Turkey has tended to focus on the historical, architectural, local and material properties [3,4]. In Turkey, there is hardly any detailed research on their construction techniques and static properties. Unfortunately, studies on the earthquake behaviour of traditional timber-framed buildings are also not very common in Turkey. The aim of this paper is to begin filling this gap and guide restoration implementations for timber-framed buildings.

The following section aims to discuss the effects of earthquakes on traditional timber-framed buildings in reference to former earthquakes, and establish the possible uses of traditional methods developed against earthquakes. The section will also offer concrete data for the restoration of traditional houses in Turkey, especially in terms of the determination of structural interventions. Several earthquakes have occurred in Anatolia between 1894 and 1999 [5,6]. The criteria used for the selection of the examples mentioned in this study are their locality (earthquake-prone areas where the timber-framed house tradition exists) and availability of information (damage reports) on the earthquakes. The consequences of the 1894-İstanbul, 1970-Gediz and lastly 1999-Marmara (or Kocaeli) earthquakes are examined from a historical perspective with reference to case studies in regions where traditional timber-framed structures are found, and the damage types and their consequences are discussed.

The consequences of the earthquake of August, 17th 1999 in Marmara-Kocaeli were examined and assessed by the author during a site survey conducted one month after the earthquake. The basic reason for including the 1894 earthquake in this study is because in that period, houses in İstanbul were mostly of timber-framed construction and sufficient descriptive data are available [7]. Similarly, there are some damage reports, which include valuable visual documents on timber-framed houses without an assessment of their physical condition, which can be used as first-hand references on the 1970 Gediz earthquake [8,9].

In the third section of the paper, prepared on the basis of the research made by the author [1], the tradition of timber-framed houses in Anatolia is defined in terms of construction techniques, material properties and earthquake-resistant features. The fourth section deals with some supporting findings from abroad, especially from Japan. The paper concludes with a discussion on the advantages and disadvantages of utilizing traditional timber-framed construction techniques in earthquake-prone areas.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات