GEOGRAPHIC DISTRIBUTION OF CONSTRUCTION SYSTEMS 
AND MATERIALS OF TIMBER-FRAMED HOUSES IN JAPAN

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ABSTRACT: This paper presents the geographic distribution of construction systems and materials used in timber-framed houses in Japan, through the analysis of questionnaire answers received from house builders. Two questionnaires were used: one for the whole of Japan and one for Mie Prefecture. House builders were extensively queried on the materials they used in different parts of timber-framed houses. We conclude that house builders in Japan use different materials for different parts, i.e., framing systems, foundations, floors, walls, and roofs. While certain materials are used across Japan, some are used more frequently in specific areas. In certain cases, this is the result of local availability of materials and/or climatic conditions requiring that a particular method be used.

KEYWORDS: Survey, Questionnaire, Regional characteristics, Mie Prefecture,

1 INTRODUCTION

Japanese construction systems and materials used in timber houses have been developed from the traditional methods of local carpenters; these systems and materials have undergone several structural, material, and legal innovations. Because of this historical course, timber housing construction in Japan still uses a variety of construction systems and materials. This paper presents the geographic distribution of construction systems and materials in relation to seismic performance of existing conventional timber-framed houses, based on the results of questionnaires given to house builders.

2 METHODS

The investigation involved two surveys: one covering the whole of Japan and the other limited to Mie Prefecture. Mie Prefecture is located between the eastern and western regions of Japan; the building systems and materials in this region are expected to have been influenced by both regions. Mie Prefecture divided into six areas based on administrative districts. The surveys used questionnaires distributed to people involved in house building, such as architects, carpenters, and construction managers.

2.1 NATIONWIDE JAPANESE SURVEY

The nationwide survey was conducted in 2004 in 46 prefectures, i.e., the whole of Japan except Okinawa Prefecture. In this paper, it is referred to as “2004 survey.” The 2004 questionnaire, with 39 questions, was printed on postcards and sent to fewer than 2000 builders. The questionnaire was returned by 541 builders, a return rate of approximately 30%.

2.2 MIE PREFECTURE SURVEY

The survey limited to Mie Prefecture was distributed in 2010 and is herein called the “2010 survey”. The questionnaire ran to eleven sheets of paper and was sent to 664 builders by post. The return rate was approximately 26% (172 builders) and the valid responses was 165. From this data, geographic data plotting, regional differentials in methods used, and chronological charting were delivered, and conclusions were drawn.

3 RESULTS

3.1 FRAMING SYSTEMS AND ELEMENTS

Figure 1 shows the geographic distribution of the modules used in timber-framed houses in Japan. The modules most widely used in Japan, especially in the eastern region, are 909-mm and 910-mm modules. In central Japan, 939-mm and 940-mm modules are partially distributed. In the western region, the 950-mm module is widely used. The 985-mm module is found exclusively in western Japan, except in Kyushu region and Okinawa Prefecture. In addition, 1000-mm modules are used across Japan.

Figure 2 shows the modules used in houses in Mie Prefecture currently and in the past, i.e., before the current modules became widely used. At present, 910-mm
modules are used in the whole of Mie Prefecture. In addition, currently and in the past, 985-mm modules tend to be used only in the Iga area, which is an influence of the Kansai region, the second largest metropolitan area in Japan. On the other hand, in the past, 940-mm modules were only used in the Hokusei area (also shown in Figure 1).

3.2 FOUNDATIONS

Presently in Japan, there are two main construction methods for foundation: continuous footing and mat foundation. Figure 3 shows the foundations used under the outer and inner walls in Mie Prefecture, based on multiple-choice questions. Over 90% of house builders use mat foundation under the outer wall. For the inner walls, approximately 60% house builders use “steel floor jack post,” 14% use “plastic floor jack post,” and 8% use “wood floor jack post on stone single footing.”

From this summarization, we conclude that house builders frequently use mat foundation under the outer walls, and simplified floor jack posts under the inner walls, not only Mie Prefecture but across Japan.

3.3 WALL CONSTRUCTION

Figure 4 shows the distribution of responses to multiple-response and essay questions on the most frequently used types of bearing wall for outer and inner walls. For both outer and inner walls, “brace” was the most common answer, (about 60% each), followed by “bearing wall panel” (over 20% and about 10%, respectively) and plywood or others (less than 10% each). The percentage of respondents using bearing wall panel for outer walls tend to be higher than that for inner walls.

From this summarization, outer and inner bearing walls are most frequently constructed using braces, although the use of bearing wall panels, such as plywood, for bearing of outer walls has gradually increased. Further, mud walls are often still used in Mie Prefecture.

4 CONCLUSIONS

In this study, we have shown that house builders in Japan use different materials for framing systems, foundations, floors, walls, and roofs of timber-framed houses. Certain materials are used across Japan, whereas some show higher incidence of use in specific areas. In certain cases, this is the result of local availability of materials and/or climatic conditions requiring that a particular method be used.

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