CONTEMPORARY MID-RISE TIMBER BUILDINGS IN JAPAN 2013

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ABSTRACT: Buildings in Japan have been constructed using timber since olden times. At the same time, Japan is a country beset by earthquake and timber buildings were weak against fire. So, from 1950 to 1987 wooden buildings over 13m height were prohibited by law. Revision of the Building Standards Law 2000 allowed the construction of timber buildings four-story or taller with fire-resistance performance.

For fire-resistance performance three type of members were developed and achieved in Japan. First type is a membrane member covered with fireproof elements like gypsum boards. Second type is a built-in steel member for self-extinguish. Last third type is a fire-stop, ‘Moedomari’, member covered with wood layer and non-combustible treat wood layer. First layer wood functions as a ‘Moeshiro’ layer for making fire-prevention time and second layer wood functions as a ‘Moedomari’ layer for self-extinguish. With membrane member many large timber building have been built from 2005.

This paper describes the detail of large timber buildings with three fire prevention system in Japan. Especially detail of two five storied buildings, M-Building and Shimouma building, were described.

KEYWORDS: Mid-rise timber building, architectural design, seismic performance, fire-resistance performance

1 INTRODUCTION

Buildings in Japan have been constructed using timber since olden times. At the same time, Japan is a country beset by earthquake and timber buildings were weak against fire. So, from 1950 to 1987 wooden buildings over 13m height were prohibited by law. Revision of the Building Standards Law 2000 allowed the construction of timer buildings four-story or taller with fire-resistance performance.

This paper describes the detail of large timber buildings with three fire prevention system in Japan. Especially detail of two five storied buildings, M-Building, and Shimouma building, were described.

2 FIRE-RESISTANCE PERFORMANCE

For fire-resistance performance three type of members shown in Figure 1 were developed and achieved in Japan. Type 1 is a membrane member covered with fireproof elements like gypsum boards. Type 2 is a built-in steel member for self-extinguish. Type 3 is a fire-stop, ‘Moedomari’, member covered with wood layer and non-combustible treat wood layer. First layer wood functions as a ‘Moeshiro’ layer for making fire-prevention time and second layer wood functions as a ‘Moedomari’ layer for self-extinguish. With membrane member many large timber building have been built from 2005. Typical structural system is 2x4 system and post and beam system. Shimouma building used this fire-prevention system.

M-Building used a built-in steel system. Finally timber buildings with ‘Moedomari’ are completed in 2013.

Figure 1: Members for fireproof construction

3 MID-RISE TIMBER BUILDINGS IN JAPAN

Using these fire-resistance member many timber buildings over four storied have been built in Japan. M-Building shown in Figure 2 were five storied timber building built in Ishikawa Prefecture in 2005 and is a first building using Type 2, built-in steel members. Main building of POLUS-TEC shown in Figure 4 is four storied timber building using Type 2 members in Saitama prefecture in 2012, too. Eastern Saitama
Regional Development Center shown in Figure 5 is a six storied mix structure building in Saitama Prefecture, 2011. Lower floor, from 1st to 4th story, are steel construction and upper floor, from 5th to 6th, are timber construction and using Type 1 members, covered by gypsum board. Shimouma building shown in Figure 3 is five storied timber building in Tokyo, 2013. Osaka Mokuzai Nakagai Kaikan is a three storied office building and mix structure with reinforced concrete construction and timber construction in Osaka, 2013. Type 3 fire resistance member, ‘Moedomari’, are used in this building.

4 M-BUILDING

M-Building was built in Kanazawa city, Ishikawa prefecture, 2005. In this building, first-story was built in reinforced concrete construction and from 2-5 stories was built in timber-based hybrid construction. In structural framing, the performance-based design method (“Calculation of Response and Limit Strength”) was applied and some static structural experiments were conducted about the seismic performance of shearing wall and the buckling stress of timber-based hybrid column. In fire resistance system, fireproof construction was needed for this building. Three fireproof elements, column, girder and bracing, were tested for 1 hour fire resistive period. All elements could have enough properties for 1 hour fire resistance. The possibilities of middle-rise and high-rise timber buildings are extended by completion of this building.

5 SHIMOUMA PROJECT

Shimouma project shown in Figure 3 is collective house built in Setagaya-ku, Tokyo, 2013. This building is built in reinforced concrete construction and from 2-5 stories was built in post and flat slab timber construction. For fire resistance column and floor and roof are covered with gypsum board. Bracing can be expose, because they are elements against earthquake and wind. These member is a simbol of timber building.

6 CONCLUSIONS

Revision of the Building Standards Law 2000 allowed the construction of timber buildings four-story or taller with fire-resistance performance. Three type of fire resistance member were achieved and many over three storied timber building have been built in Japan. The possibilities of mid-rise and high-rise timber buildings are extended by completion of these buildings.