

Application of modern timber structure in short and medium span bridges in China

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Abstract: A series of problems about Chinese bridges with short and medium span recent years were analyzed in this paper. The necessity and feasibility of modern timber structure applied in short and medium span bridges in China were also put forward. The results showed that the short and medium span bridges had many problems, such as monotonous structural forms, serious environmental pollution, multiple bridge defects and difficulty in maintenance. With the development of connection and maintenance technology of modern timber structure and its advantages of light self-weight, environmental coordination, high carrying capacity, excellent durability and abundant structural forms, it was necessary and feasible to apply modern timber structure in short and medium span bridges in China. More emphasis on the construction of modern timber structure should be conducted to expand its application scopes and improve the construction proportion of short and medium span timber bridges.

Key words: short and medium span bridges; timber structure; modern timber bridge; application scope

1 Introduction

At present, the highway bridge construction in China is in a rapid development period. At the end of 2012, the quantity of Chinese highway bridges reaches 713400, including 649000 short and medium span bridges, which account for 90.97% of the total bridges.

Timber bridge has a long construction history in

China and plays an important role in Chinese development (Zhou et al. 2011). Timber structure has many advantages; light self-weight, environmental coordination, high carrying capacity, excellent durability and abundant structural forms. In addition, it has wide applications in many countries (Liu et al. 2012; 2013). Therefore, making timber structure applied in Chinese short and medium span bridges will bring great techni-

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cal, economic and environmental benefits.

In order to enrich structural forms of Chinese short and medium span bridges, avoid the material over-reliance on cement and steel, and reduce multiple bridge defects, this paper analyzed these problems and put forward the necessity and feasibility of the application of modern timber structure in short and medium span bridges in China. It is hoped that more emphasis should be conducted on the construction of modern timber structure to expand its application scopes and the construction proportion of short and medium span timber bridges should be improved.

2 Existing problems of short and medium span bridges in China

The quantity of short and medium span bridges in China presents a growing trend year after year, as shown in Fig. 1. They face a series of problems, such as monotonous structural forms, serious environmental pollution, multiple bridge defects and difficulty in maintenance (Li and Sun 2003; Li 2005; Ma 2007; Li 2010; You et al. 2011).

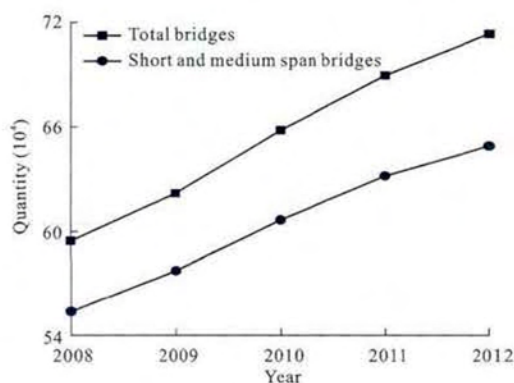


Fig.1 Quantity of Chinese highway bridges

2.1 Monotonous structural forms

Most of bridges in China are short and medium span bridges, which are usually designed with monotonous forms causing visual fatigue and increasing the probability of traffic accidents. At present, the main structural forms of Chinese short and medium span bridges are plate and beam bridges, such as assembly-type hollow plate assembly-type T girder bridge, assembly-type small box girder bridge and cast-in-place continuous beam

bridge, without sufficient bridge, aesthetics.

2.2 Serious environmental pollution

Nowadays, the materials of short and medium span bridges are mainly concrete and steel in China. They consume non-renewable mineral resources and release CO₂ as well as dust in production process. Previous researches show that 0.8 tons CO₂ will be released during per ton cement produced, which is half of steel production. More than 60% of the world's cement is produced in China and the cement consumption per capita per year in China is about 1529 kg, more than four times of the world's average (265 kg) as shown in Fig. 2 (Zhu 2012). In addition, a large number of solid wastes will be produced when the concrete bridges are out of service. With the high-speed construction of short and medium span bridges in China, it is urgent to make full use of environmental materials. Timber is an environmental material for it is not only a renewable material, but also can release O₂ and assimilate CO₂.

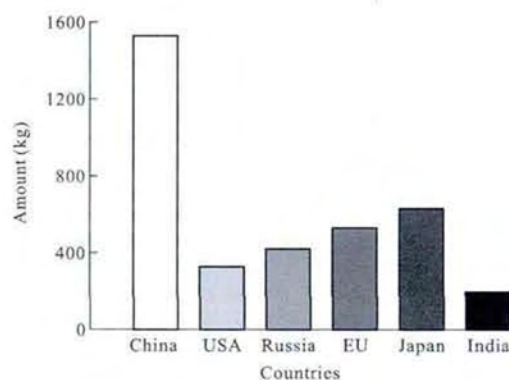


Fig.2 Cement consumption amount per person

2.3 Multiple bridges defects

In recent years, the destruction and collapse frequently occur in the existing highway bridges. Among these bridges, the proportion of short and medium span bridges is more than 90%. The common problems at present are crack, excessive deflection, steel bar corrosion, the uneven settlement and so on.

Taking hollow slab structure for example, the common problems are hinge joints cracking between precast hollow slab, longitudinal and trans-

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