Chapter 6
Wood Bridges

6.1 Introduction

Madsen, a leading expert in his times in the structural use of wood made a clear distinction between the terms *wood* and *timber*. He used the former term for defect-free samples, which are employed for determining the fundamental properties of this building material, and reserved *timber* for that useful construction material, which is produced from logs of trees (Madsen 1992). Notwithstanding these definitions, both the terms are used interchangeably in this book as is done commonly in technical literature dealing with the structural applications of timber.

Because in its untreated state it is susceptible to biodegradation, timber is sometimes considered to be unsuitable for permanent and outdoor structures. It has been established, however, that well-treated wood can prove to be a durable material even in warm and humid climates.

Durability There are many examples of well-treated wood having lasted a long time in the outdoors. An example of the durability of wood is the Sioux Narrows Bridge, a photograph of which is presented in Fig. 6.1. This bridge, which had a record span of 64 m, was built in 1936. After about 70 years of uninterrupted service, this bridge was taken down to make room for a wider bridge, and not because of its lack of durability.

The trusses of the Sioux Narrows Bridge, which was located in the northern part of the Province of Ontario, Canada, were made from Douglas fir, pressure-treated with oil-borne creosote. Douglas fir is a soft wood that receives the preservative treatment easily; it has several varieties, of which the Coastal Douglas Fir growing near the west coast of Canada and USA "forms some of the tallest and most magnificent woods in the world" (Mitchell 2014). The timbers of Sioux Narrows Bridge were so durable that the stringers of this discarded bridge were used recently to conduct lab research on the shear strength of stringers as it is affected by the distance of their supports to their ends (Das 2010).

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Fig. 6.1 The Sioux Narrows bridge in Ontario, Canada which was believed to be the longest-span timber bridge in the world

Hardwoods, which are in any case not recommended for permanent outdoor structural applications, are difficult to treat. The secret of having durable timber bridges is to make them out of species, which are easily treatable.

Recently, water-borne preservatives have come to the fore in the treatment of woods against biodegradation. However, their effectiveness is still being debated. It is argued by some experts that unlike timber treated with oil-borne preservatives, water-borne treatment does not seal the wood against the migration of moisture, thereby leading to rapid drying and thence to the development of longitudinal cracks, or checks, in the timber. Another disadvantage of water-borne preservatives is that when the timber is allowed to be saturated with water, its compressive strength in the direction perpendicular to the grain is reduced considerably. This is a serious shortcoming when timber with water-borne treatment is used in the new forms of bridges presented in this chapter.

New Developments In recent years, significant developments have taken place, mainly in Canada and the USA, in the structural forms of wood bridges. The new structural forms that have emerged as a result of these developments permit the use of wood more effectively and efficiently than had been possible in the past. The main purpose of this chapter is to present in summary several new forms of timber bridges.

6.2 Stress-Laminated Wood Decks

The term *nail-laminated deck* is used for a bridge made of sawn timber planks which are about 30–60 mm thick and 150–250 mm wide in cross-section, and which, are usually referred to as laminates. The laminates, with the longer sides of their cross-section vertical, are successively nailed together to form the solid deck, which constitutes the superstructure of the bridge. The length of the laminates, running along the deck in the longitudinal direction, is much shorter than the span