Table of Contents

5.21 STRESS WAVE TIMERS

5.21.1 Introduction

The presence of decay in timber bridges can be difficult to detect. But the extent and location of such decay can have significant effect on the engineering characteristics of timber and the load rating of timber bridges.

Sounding the timber elements with a hammer is the most basic type of inspection (Chapter 3). But this can be difficult to interpret, and at best, can only give you an indication that decay is present, but cannot be used to determine the extent of the decay. It also has limited detection on large timber members, on members like piles that have surface delamination near the water line (giving a false positive), and on large preservative treated timbers that may have an intact exterior, where the preservative treatment has penetrated, but has a decayed core.

In the past, incremental boring tools were used to better judge the extent of the decay. But that tool is slow, takes a lot physical strength by the inspector, is difficult to interpret, and is a destructive testing methods. Increment boring should only be used as a last resort.

Stress Wave Timbers (SWT) and resistance micro-drilling (Chapter 20) can both be used to detect the extent of decay. SWT measures the time that a pulse travels through a timber. The pulse travels much faster in sound, dense wood than in decayed wood, so decay can be detected and its extent can be quickly estimated. There is no penetration of the preservative envelope on the timber. Though judgment must still be used, this can contribute to higher level of confidence in timber bridge inspections. There are several brands of stress wave timers with each fast to operate. Pulses are either generated with a hammer hit, or the instrument generates its own pulse. The time for the pulse to travel in the wood is registered by the instrument and is noted by the inspector and can be saved to a computer file.

SWT for timber is similar to Ultrasonic Testing (Chapter 5) and Ultrasonic Pulse Velocity (Chapter 13).

5.21.2 Applications

Before using SWT, the entire bridge structure should have a preliminary inspection by quickly hitting all the bridge members with a hammer and listening for a resulting hollow sound. The inspector should visually observe the overall condition of the timber, note the presence of moisture, and the age of the structure. A bridge with no discernible defects need not have further analysis with NDE. But if any of the timber is suspected of having decay, its presence and extent must be confirmed by NDE testing.

For structures where decay is suspected and detected, it is good practice to survey the entire structure. This baseline can be used to measure the progression of decay and aid in determine whether and when the structure must have repairs and/or replaced.

SWT can be used on timber bridge beams, decks, abutments, piles, and railings. Forms should be used to facilitate the track of the data from year to year, and to accurately note where the testing was done and the extent of the suspected rot. Diagrams must be made

and used to record the location of the testing, and it must be saved in a location to assure future inspectors have access to the information.

The inspector must analyze the results, summarize the finding and include this in the inspection folder and the HSI database.

SWT does not measure an absolute value of soundness of wood. The speed of the pulse is determined by decay, but also the species of the wood, and the presence of other defects such as splits. Therefore, a baseline should be used on a known sound piece of wood on the bridge or other similar sized and treated timber.

On a creosote treated Douglas Fir 12x12 pile cap, the typical time for a pulse to travel through the wood is between 400 and 600 microseconds. But in a decayed pilecap, the time will be 1500 or more microseconds.

SWT is fast and more than a hundred readings can be taken in a day.

Models available are the Fakopp Microsecond Timer, Metriguard Stress Wave Timer, and the Silvatest Duo. Prices range from $2,000 to $4,000.

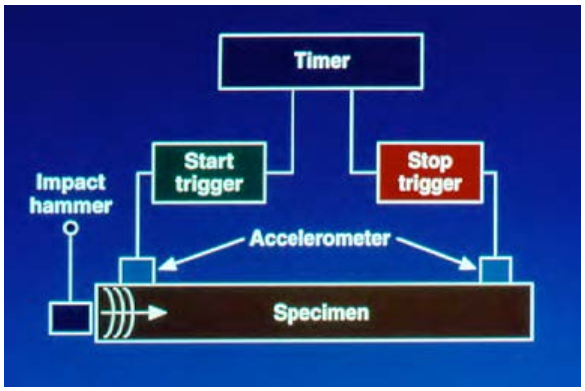

Figure 5.21.2-1: Schematic of a Stress Waver Timer

Figure 5.21.2-2: Stress Wave Timer using impact hammer

Figure 5.21.2-3: Stress Wave Timer using automated pulses.

5.21.3 Limitations

This method will only work on timber with access to two sides. Decks usually will not have two sided access, and some beams may be too close together to use SWT. Proper interpretation requires comparing to a timber that is known to be sound. False positive can be caused by internal split in the wood that does not impact the structural characteristics, and by delamination of the rings on the surface of piles at the waterline. The latter case is most likely caused by decay occurring and its limitation often means that the SWT cannot be used.

Experience is necessary to estimate the extent of the detected rot.

The exact location of the decay cannot be determined, only that there is decay. In most cases, a resistance microbore is a better choice (Chapter 20).

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