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5.20 RESISTANCE MICRO-DRILL

5.20.1 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.

Visual inspection (Chapter 2) and sounding (Chapter 3) the timber elements with a hammer is the most basic type of inspection. But these 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 or damage near the water line 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, increment boring tools were often used to determine 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 partially destructive testing method. Drilling into the timber with a brace and bit has also been used and the resistance can estimate the extent of decay. Boring of any type leaves large holes which are hard to seal and become a source for accelerated decay should only be used as a last resort.

Stress Wave Timbers (Chapter 21) and resistance micro-drilling can both be used to detect the extent of decay. Resistance micro-drilling pushes a small 1.5mm bore (with a flared 3mm tip) into the wood and a microprocessor measures the relative resistance. The bore does not drill into or remove wood, but forces its way into the fibers, thus it is a NDE. In most cases, the timber's preservative treatment envelope is not violated. The wood's resistance to the micro-bore is either recorded on paper or is saved to a computer file. This allows the operator to determine the amount of decayed wood and remaining cross section. The resistance of the wood depends on the species, moisture content, and whether the temperature is freezing, and the direction of the grain. Calibration of the instrument is not as important as taking a baseline reading on known sound wood and comparing that to the rest of the borings in similar wood.

This instrument can contribute to a much higher level of confidence in timber bridge inspections. Newer instruments can do a bore in about a minute and the batteries will last about 100 bores. Older machines are slower and more battery intensive.

Models available are the IML Resistograph. Older models are available for around \$4,000, but the newer, faster models are recommended and cost about \$7,500.

5.20.2 Applications

Before using a resistance micro-drill, 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. Bridges less than 30 years old normally will not need this extensive of testing. But if any of the timber is suspected of

having decay, its presence and extent must be confirmed by NDE methods. 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 determining whether and when the structure must have repairs and/or be replaced. All data should be stored in the hard copy file and scanned in and stored in the HSI database. Future inspection can then estimate if the decay is spreading. All determinations of cross section loss should be given to a bridge load rating engineer to determine whether posting is needed. Refer to figures 5.20.2-1 and 2 for images of Resistance Micro-Drill being used on piling.



Figure 5.20.2-1: IML Resistograph, note the other old borings from a regular drill

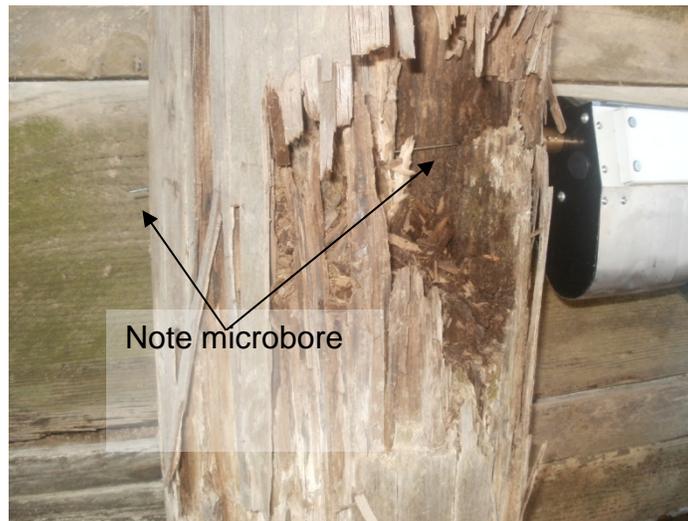


Figure 5.20.2-2: Photograph of Resistance Micro-Drill boring through severely decayed pile.

Resistance micro-drills can be used on timber bridge beams, decks, abutments, piles, and railings. Forms should be used to facilitate the tracking of the data from year to year, and to accurately note where the testing was done and the extent of the suspected rot and its

increase over time. The forms documenting the data must be saved in the hard copy file and scanned and placed in the HSI database. Refer to figures 5.20.2-2 thru 5.20.2-4 for images taken from a resistance micro-drill.

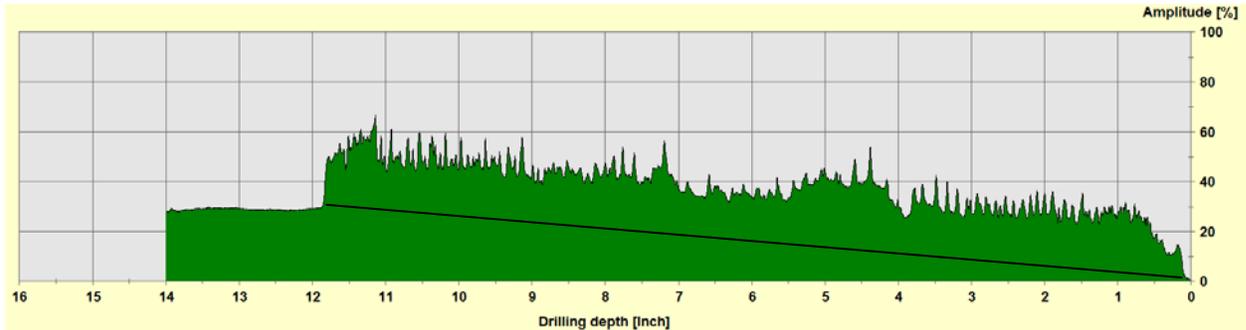


Figure 5.20.2-3: Micro-drill output of good, sound piling

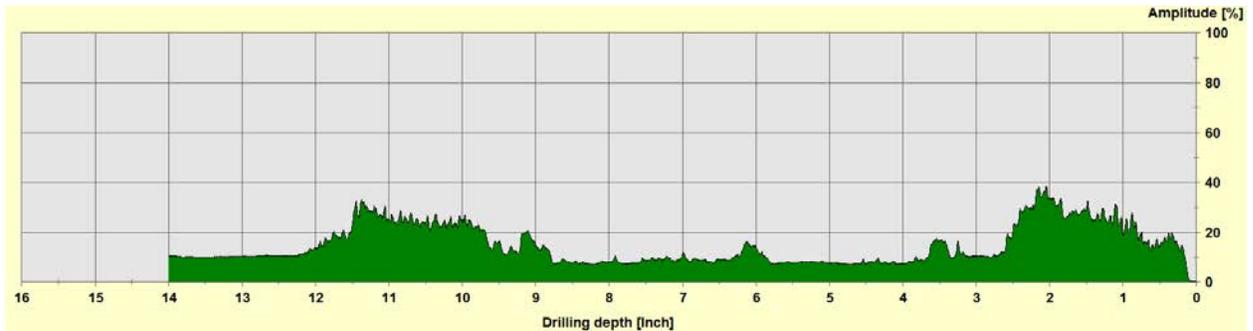


Figure 5.20.2-4: Micro-drill output a decayed pile showing 7” hollow.

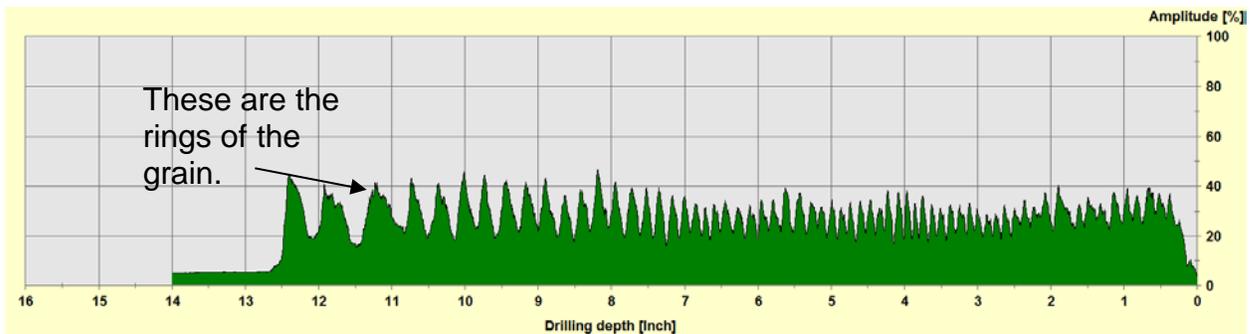


Figure 5.20.2-5: Micro-drill output of good, sound beam.

5.20.3 Limitations

Limited access caused by closely spaced member may limit areas where the micro-drill can be used.



The micro-drill cannot make absolute distinction between sound wood and incipient decay. Comparisons to bores in known sound wood must be used and experience must be used to accurately judge the decay. The original grading of the timber takes into account naturally occurring defects in the wood. As wood is decaying it is difficult to judge to when the decay is impacting the engineering characteristic of the wood and how the decay advances over time.

The soundness of the wood is only measured at the bore's penetration, multiple bores can be made and all areas of suspect wood can all be bored in different direction to estimate the extent of the decay. Judgment must still be used in determining the areas to bored and it is very possible to miss a decayed area. Voids are easily detected and usually one can tell if this is a natural defect (not a structural issue as the grading takes those into account) or advanced decay.

A way to charge the batteries off a vehicle's electrical system must be carried as part of the inspector's tools. A laptop can also be taken to download files.



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