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BARTLETT TREE EXPERTS

240 HIGHLAND AVENUE, SEEKONK, MA 02771 • (508) 336-9330

Mr. Todd Brayton, P.E.
12 Breakneck Hill Road
Lincoln, RI 02865-3826

Subject: Hazardous Tree Analysis
1R Highway Improvements to Hope Street (RI Route 114)
Thames Street to Constitution Avenue
Bristol, RI

Bartlett Tree Experts has completed a field inspection of six trees noted to have significant structural deficiencies within the stem of each tree. Initial inspections were conducted from the ground by visual means. Each tree within the project limits was inspected and visually evaluated for defects. It should be noted that this method of inspection only identifies conspicuous deficiencies visible from the ground. When significant deficiencies were noted from the ground, Bartlett Tree Experts noted those trees for further evaluation. The next level of evaluation for those trees noted to have conspicuous hazards involved the climbing of each tree to determine the extent of each hazard. A resistograph machine was used to determine the extent of decay within wounds found in each tree.

It should be noted, that we do not have any method available that will definitively predict stem or limb failure in a tree. Our recommendations are based on our experiences and industry procedures for determining the risk of failure in each tree noted. Since we cannot definitively predict failure in any tree, whether it has an obvious defect or not, the only way to eliminate risk is to remove the trees noted to have obvious defects.

Our report will provide guidelines for those who share the responsibility to the community and the associated liability. RIDOT and/or their designees shall be responsible for determining if cultural, historic, and/or aesthetic quality of each tree offsets the inherent risks associated with trees that have structural deficiencies. All of the trees below unless otherwise noted, should be removed to eliminate hazardous conditions unless RIDOT or their designee agrees to accept the liabilities associated with the risks of maintaining trees that have structural deficiencies.

The methods used to assess each tree noted as hazardous are outlined in the attached, Bartlett Tree Research Laboratories technical report titled, Guidelines for Quantifying and Evaluating Wood Decay in Stems and Branches. The following trees were identified as hazardous and were evaluated according to the noted methods.

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Tree ID	Station	Number	Diameter	Common	Hazard	Height
172	188	40	29	little leaf linden	No defects/no removal	Large (>35')
214	215	80	56	little leaf linden	Possible Removal	Large (>35')
478	203	95	44	little leaf linden	No significant defects	Large (>35')
486	201	10	26	horse chestnut	No significant defects	Large (>35')
503	194	20	36	little leaf linden	No significant defects	Large (>35')
517	188	20	34	little leaf linden	Remove ASAP	Large (>35')

Tree #172, No defects, no removal

Tree number 172 at station 188+40 RT, was inspected. No significant cavities or defects were identified. No decay found to the depth of the resistograph probe, 15 inches.

Tree #503, little leaf linden, no significant defects.

Tree number 503 at station 194+20 RT was inspected. No significant cavities or defects were identified to probe.

Tree #214, little leaf linden, hazardous: candidate for removal.

Tree number 214 at station 215+80 RT was inspected. An average of 7.6 inches of sound wood at approximately 6 feet from the ground. This tree has a large longitudinal cavity at approximately 6 ft. from the ground. An average of 9 inches of sound wood is the threshold for a tree of this diameter.

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Probes taken at 12 and 14 feet from the ground suggested similar conditions throughout the trunk of this tree.

This tree should be removed to eliminate the hazard. The risk of this tree to public health and property damage is significantly high.

If the tree remains because of cultural and historic value, steps should be taken to inspect the tree after each and every storm for cracks and/or changes in the condition of this tree. Cables should be installed and weight reduction pruning should be done to reduce risk of failure.

Tree #478, little leaf linden, data suggests no significant defects.

Tree number 478 at station 203+95 LT was inspected. An average of 10.75 inches of sound wood was found at the height of the cavity. Since the threshold for a tree this size is approximately 8 inches, the 10.75 inches of sound wood suggests that this tree may be of reasonable risk. It appears that this tree does not have to be removed. If this tree remains, it should be inspected yearly for defects and any risk reduction practices identified in the RIDOT tree inventory for this project should be applied.

Tree #486, horse chestnut, data suggests no significant defects.

Tree number 486 at station 201+10 LT was inspected. An average of 7.13 inches of sound wood was found at the height of the cavity. Since the threshold for a tree this size is approximately 4.5 inches, the 7.13 inches of sound wood suggests that this tree may be of reasonable risk. It appears that this tree does not have to be removed. If this tree remains, it should be inspected yearly for defects and any risk reduction practices identified in the RIDOT tree inventory for this project should be applied.

Tree #517, little leaf linden, remove to eliminate risk

Tree number 517 at station 188+20 LT was inspected. An average of 5.25 inches of sound wood at approximately 4.5 feet from the ground. An average of 4.5 inches of sound wood is the threshold for a tree of this diameter. This tree is vulnerable to high winds as it is exposed to the open harbor. It has a

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very unbalanced canopy because of utility pruning, and is in a high target area. This tree should be removed immediately to eliminate risk. If this tree remains, the risk of injury and/or property damage will be unacceptably high.

BARTLETT TREE RESEARCH LABORATORIES
CHARLOTTE, NC

Technical Report

Guidelines for Quantifying and Evaluating Wood Decay in Stems and Branches.

Bruce R. Fraedrich, Ph. D., Plant Pathologist

Introduction

Decay is a leading factor that predisposes branches and stems to failure. The size of the decay column relative to the diameter of the branch or stem can be an important determination to assist in assessing whether a stem or branch poses a severe risk of failure. This Technical Report provides guidelines for measuring and evaluating decay in stems and branches to help assess failure potential.

Measurements

Visually assess stem and crown to determine weakest area due to decay. In some instances, several sites on the stem and/or branch may require evaluation.

D = Stem Diameter

C = Circumference = D X 3.14

W = Width of Cavity Opening

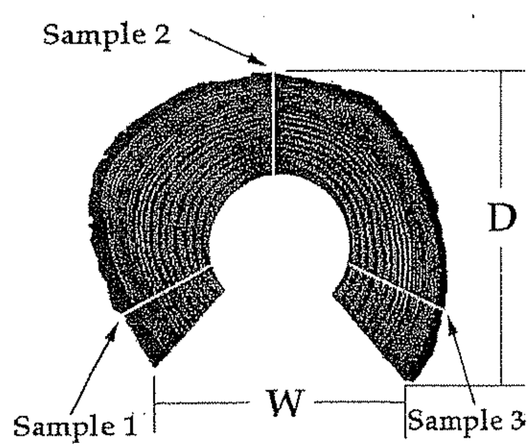
$$\% \text{ Cavity Opening} = \frac{W}{C} \times 100$$

$$\text{Average Thickness of Sound Wood} = \frac{\text{Depth to Decay: Sample } 1+2+3}{3^{*}}$$

* Number of Sample Sites

Measure stem/branch diameter (**D**) at weakest point. Subtract twice the bark thickness to obtain the wood diameter at the defect. If a cavity opening is present, then measure width of opening (**W**). Multiply stem/branch diameter (**D**) by 3.14 to obtain circumference (**C**) at weakest point (**C=D X 3.14**). Determine the percentage of the circumference with cavity opening by dividing the width of the opening (**W**) by circumference (**C**) and multiplying by 100 (**% Cavity Opening = W/C X 100**).

Calculate the average thickness of sound wood surrounding the defect by probing with a 1/8" drill bit (with long flute) and battery operated drill. Drill into sound wood until resistance



significantly decreases, when decay is encountered. Extract drill bit and measure depth to decay. Subtract bark thickness from measurement. Sample a minimum of three sites on all stem/branches with an additional site per 10 inches of wood diameter. Increase sampling when sample depths vary greatly. A Resistograph or an increment borer can be used in lieu of the drill and drill bit.

Add together the sample values and divide by the number of sample sites to obtain an average thickness of sound wood surrounding the defect.

Thresholds

Refer to **Table 1** for the minimum thickness of sound wood surrounding decay columns with and without cavity openings. Corresponding to the size of the cavity opening (left column), multiply the stem/branch diameter by the fraction in the right hand column to obtain the average minimum thickness of sound wood to support the stem or branch. **If the actual** minimum thickness is less than that value, then the stem/branch probably represents a high risk of failure.

Table 1. Minimum thickness of sound wood surrounding decay columns on stems and branches with and without cavity openings.

Cavity opening % of circumference	Minimum Thickness of Sound Wood Surrounding Decay **(Wood Diameter X)**	
	High Risk	**Critical Risk**
0	0.15	0.10
5%	0.17	0.11
10%	0.18	0.12
15%	0.20	0.14
20%	0.23	0.15
25%	0.26	0.17
30%	0.33	0.18

Many factors interact with decay to cause failure of stems and branches. In many instances such as when multiple defect are present, species wood characteristics are weak or prone to failure or decay is present at stress points, the thickness of sound wood surrounding the decay column must be greater than the minimum specified in Table 1. The minimum thickness of sound wood should be increased in the following instances:

- Leaning stems/branches
- Trees with unbalanced crowns or low crown ratios
- Trees with multiple defects
- Decay present at a stress point (such as mid-crown region of stem, bend in stem or limb, decay in reaction wood)
- Tree species with weak or brittle wood characteristics (including red maple, silver maple, poplar, tulip poplar, linden, horsechestnut, and cottonwood)
- Stem/branch with asymmetrical decay columns
- Trees with declining vitality
- Trees in highly exposed locations
- Sensitive target locations / high use site

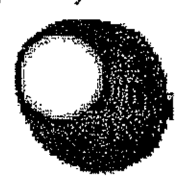


Figure 1. ***Graphic representation showing minimum thickness of sound wood for decayed stems/branches with and without cavity openings*** *(For Severe Risk).*

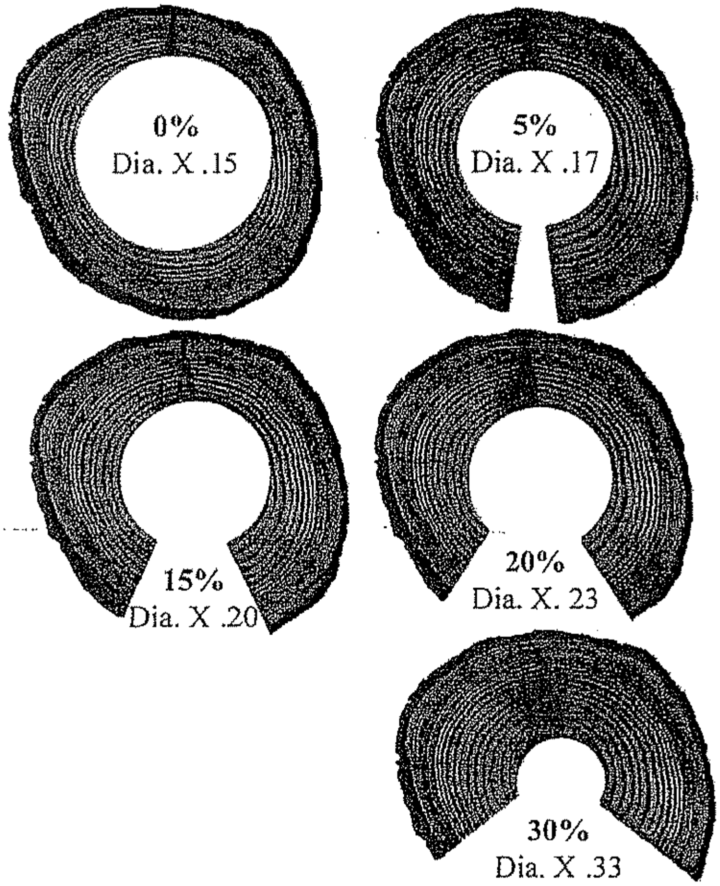


Table 2. Minimum average thickness of sound wood surrounding decay columns with and without cavity opening to be considered a **severe** defect.

	Cavity Opening% Circumference						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Stem Diameter	*(Minimum Thickness (inches) of sound wood)*						
10	1.5	1.7	1.8	2	2.3	2.6	3
15	2.25	2.55	2.7	3	3.45	3.9	4.5
20	3	3.4	3.6	4	4.6	5.2	6
25	3.75	4.25	4.5	5	5.75	6.5	7.5
30	4.5	5.1	5.4	6	6.9	7.8	9
35	5.25	5.95	6.3	7	8.05	9.1	10.5
40	6	6.8	7.2	8	9.2	10.4	12
45	6.75	7.65	8.1	9	10.35	11.7	13.5
50	7.5	8.5	9	10	11.5	13	15
55	8.25	9.35	9.9	11	12.65	14.3	16.5
60	9	10.2	10.8	12	13.8	15.6	18