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The 2019 MFI will be held at Moonstone Hotel's Oregon Garden Resort, located about one hour south of Portland, OR. You can visit the Oregon Garden website for details, but note that you may NOT reserve a room for MFI through that website.

Please do not make any air travel reservations for MFI 2019 until you have received your acceptance email in late December 2018. This email will contain travel guidance including information about group transportation arrangements from the PDX airport to the Oregon Garden Resort.

MFI 2019: What to Expect

Required Institute Pre-Work

Part of the MFI experience involves readings and online discussions that will be held during January and early February, 2019. If you're accepted into MFI 2019, you'll need a valid email address and internet access from work or home. Plan on spending about 1-2 hours a week for 5 to 7 weeks on the Institute Pre-Work.

Instructors

The MFI 2019 instructional staff comes with decades of experience in all phases of urban forestry, at the municipal, state/provincial, federal, private, and non-profit levels. Most MFI teaching teams have over 100 years combined urban forestry expertise.

MFI Week Schedule

MFI is an intensive learning experience. You must be able to attend from 4 pm on Sunday until noon on Friday.

There are numerous breaks and a little free time, but the event involves a rather demanding and time-intensive schedule. Though there are sights to see in the area, plan to see them before or after, not during MFI. Your full attendance will be required at every session - partial attendance is not possible. Sorry but pets, partners, and dependants or guests cannot be accommodated at MFI.

Online Registration is Now Open at www.urban-forestry.com

The Visual Tree Assessment One-Third Rule:

Frequently Applied, but Mostly Irrelevant

by Frank Rinn
Owner of RINNTECH,
Executive Director of
ISA Germany, Heidelberg

Shortly after it was introduced, the "Visual Tree Assessment (VTA) One-Third Rule" (see for example: Mattheck et al. 1993) became a popular criterion for evaluating the breaking safety of urban trees around the world. The One-Third Rule (t/R>1/3) posited that as soon as the thickness of the outer intact shell-wall (t) of a hollow or decayed tree stem is less than 1/3 of the local radius (R), this stem section was supposed to be significantly more likely to break under wind loads.

Many, if not most, arborists interpreted the One-Third Rule as defining a clear line between "safe" and "unsafe," making risk assessment seem correspondingly clear and easy. As a central part of the VTA concept (Mattheck & Breloer 1994), the One-Third Rule is still the most commonly applied tree-breakage safety threshold around the world.

However, since its introduction, the One-Third Rule has been increasingly criticized, especially by experts preferring the Static Integrated Assessment (SIA) method for evaluating tree safety (Wessolly & Erb 1998). Gruber (2007; 2008) for example, criticized the VTA One-Third Rule as "scientifically unproven," "mono-causal," and "untenable failure criteria for trees." On www.dasgruen.de and other websites, publications and statements from various authors of note can be downloaded in support of Gruber's criticism of the use of the One-Third Rule and other VTA thresholds, such as the ratio of tree height over diameter at breast height (H/D).

In addition, many arborists have observed trees with small or no defects breaking (Fig. 1), while mature trees stand on thin shell walls for decades (Fig. 2). These observations are commonly interpreted as confirming Gruber's criticism that the VTA One-Third Rule is not correct, and resulted in many arborists switching from VTA to SIA for tree-safety purposes. This shift from one method to the other was accelerated since the SIA concept is supported and applied by many tree safety experts and university professors. As a consequence, the freely available SIA tree-safety calculation form is used by an increasing number of arborists around the world. >>

Figure 1. Two of many examples of broken conifer trees (in these cases, of Picea abies). The tree on the left had a small defect in the center at the stem base with t/R≈1/2 but broke on a height where t/R≈4/5 (>1/3). The tree on the right was fully intact (t/R=1) and broke in a combination of torsional and dynamic loading in a thunderstorm.

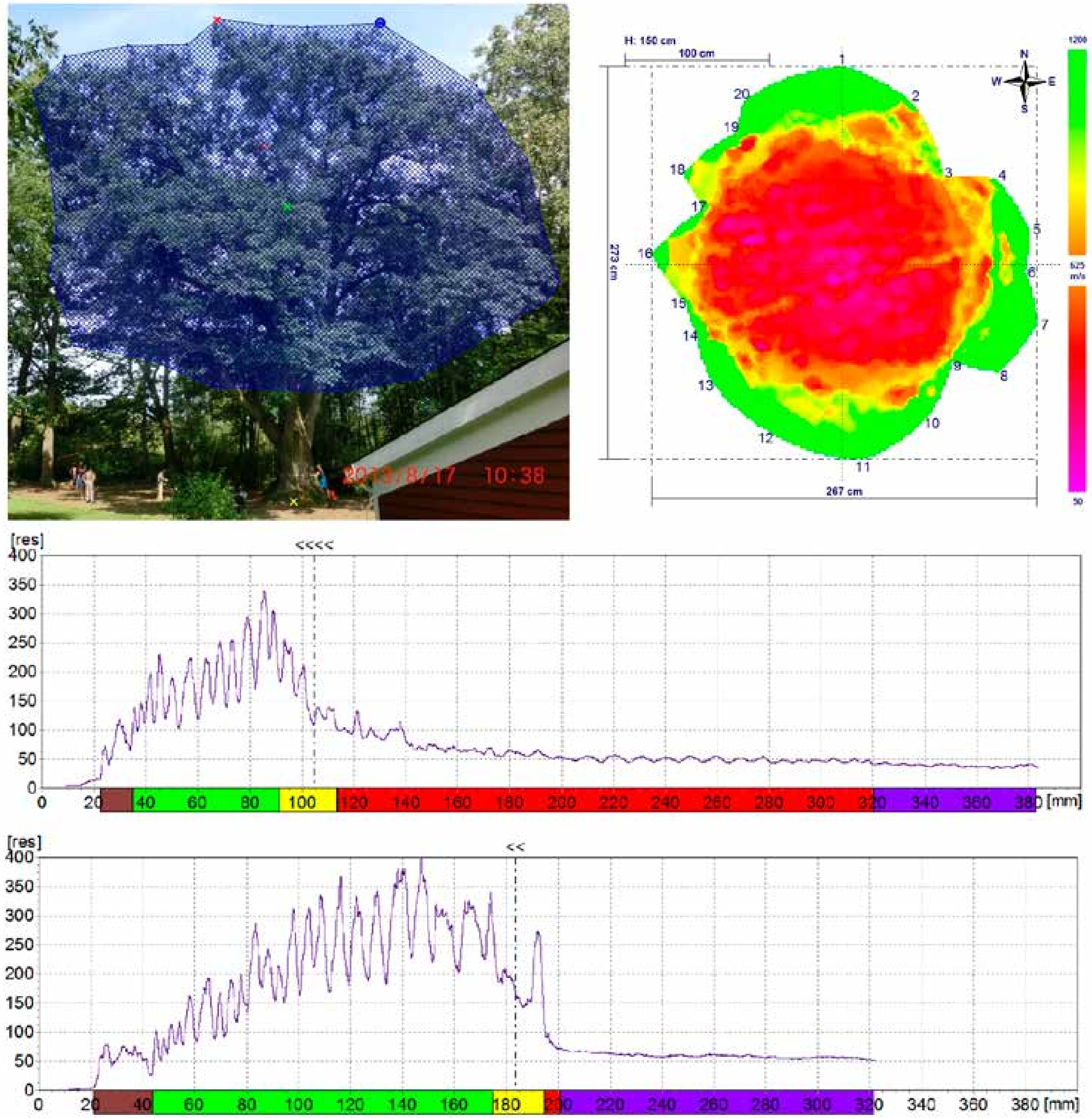


Figure 2. This mature oak tree (Quercus rubra) has a diameter at breast height of more than 2.5 meters (8.2 feet). As can be seen by the sonic tomograph (Rinn 1999, 2014b) and the resistance drilling profiles (Rinn 1988, 1990, 2016), the intact outer shell wall ranges from a few to approximately 30 cm (12 inches). The average shell-wall thickness is less than 25 cm (10 inches), which means t/R<1/5 (<1/3). This tree is standing despite heavy defects, being hollow for decades, and achieving a height of more than 25 m (75 feet).

Arborists strictly applying the One-Third Rule as commonly understood usually condemn such trees as being unsafe or tend to recommend strong pruning and even cabling. However, often there is no need for that—and heavy reductions can significantly contribute to an accelerated spread of internal fungal decay (Rayner & Boddy 1983). Applying the tree-safety concept presented in this article leads to different conclusions for such mature trees and mostly results in nothing to be done or just pruning the crown symmetrically in order to prevent wind-induced torsional loads.

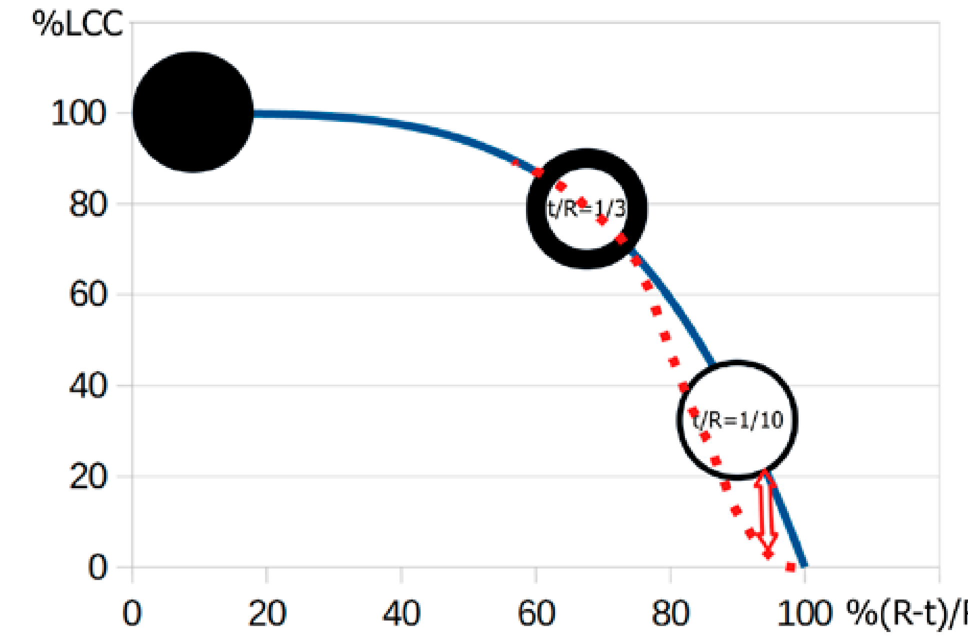


Figure 3. The blue line in this graph shows how the relative load-carrying capacity (% LCC) of a cross-section as represented by the "section-modulus" depends on the ratio of shell-wall thickness divided by the radius. Starting at top left with an intact cross-section, the load-carrying capacity is 100%. Going right, the centrally located void gets bigger and the curve shows how this impacts LCC.

Surprisingly not only to many arborists, with t/R=1/3, the central void covers approximately 45% of the cross sectional area but leads to a loss in load-carrying capacity of only about ~20%. From this point on, however, with further decreasing shell-wall thickness and increasing void size, the loss in load-carrying capacity increases more significantly than before. Because of that, t/R=1/3 is seen by many as a turning point at which to start worrying about stability. But this is, as explained in the article, only valid for trees still growing in height.

Spatz and Niklas showed (2013) that the real load-carrying capacity (red dotted line) is significantly smaller as the section modulus (used by the SIA concept) suggests as soon as the shell wall gets significantly thinner than 1/3 (depending on void length and other specific properties), mainly due to shear and torsional stresses.

Over the years, the criticism of the "mono-causal" VTA criteria developed into a mono-culture of SIA dominating nearly all tree-care conferences, journals, and educational institutions in the area of tree safety. This trend is not only seen in Germany where the debate started but worldwide: even at an international tree-biomechanics conference in the U.S., for example, nine out of ten presentations criticized VTA (and drilling) and instead promoted one company's SIA and related diagnostic products.

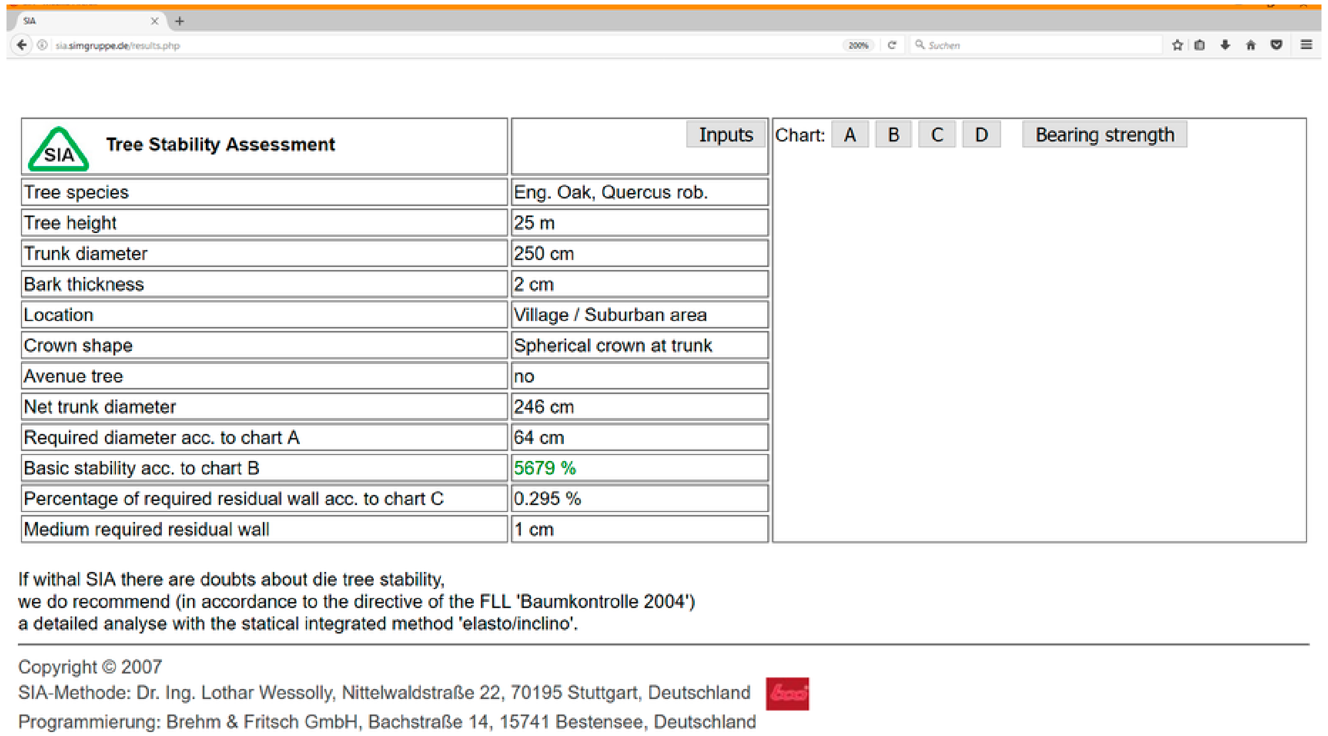
Mattheck and Bethge responded clearly to the criticism of Gruber, Wessolly, and others (2007; 2008) and claimed that VTA and the One-Third Rule are valid results of reliable scientific studies and that SIA is based solely on unproven assertions. In 2009, Fink (a widely respected forest pathologist) confirmed Mattheck's statements and clearly contradicted Gruber's positions as well.

This debate left many arborists and experts in confusion; even in 2018, by far the most frequently asked question in my workshops around the world is, "Who is right: VTA or SIA?" This is frequently in conjunction with, "Can we still use the One-Third Rule for safety evaluations although most well-known experts now prefer and promote SIA?" Thus, there is a need for clarification.

Literature from the very few tree-biomechanics scientists without economic interests in the tree-safety-business (Spatz & Niklas 2013) brings two clear answers:

1. t/R=1/3 is an important turning point of the curve describing the load-carrying capacity of hollow cross-sections (Fig 3).
2. The SIA-calculation of breaking safety strongly overestimates the load-carrying capacity of hollow trees, partially because the wrong formulas are being used (Fig. 4).

Thus, the scientific aspects are very clear (and explained in more detail in: Rinn 2018b). But when applying this knowledge about the >>



Tree Stability Assessment	Inputs
Tree species	Eng. Oak, Quercus rob.
Tree height	25 m
Trunk diameter	250 cm
Bark thickness	2 cm
Location	Village / Suburban area
Crown shape	Spherical crown at trunk
Avenue tree	no
Net trunk diameter	246 cm
Required diameter acc. to chart A	64 cm
Basic stability acc. to chart B	5679 %
Percentage of required residual wall acc. to chart C	0.295 %
Medium required residual wall	1 cm

Chart: A B C D Bearing strength

If withal SIA there are doubts about die tree stability,
we do recommend (in accordance to the directive of the FLL 'Baumkontrolle 2004')
a detailed analyse with the statical integrated method 'elasto/inclino'.

Copyright © 2007
SIA-Methode: Dr. Ing. Lothar Wessolly, Nittelwaldstraße 22, 70195 Stuttgart, Deutschland
Programmierung: Brehm & Fritsch GmbH, Bachstraße 14, 15741 Bestensee, Deutschland

Figure 4. This free SIA Tree Stability Assessment online form determines the so-called "basic stability" (breakage safety factor of the tree with an intact stem) as well as the "medium required residual wall" for sufficient safety. Using this form with the oak tree shown in Fig. 2 with a total height of more than 25 meters (75 feet) and a stem diameter of 2.5 meters (100 feet), the minimum wall thickness for sufficient safety has to be 1 cm (0.4 inches) according to SIA. This obviously incorrect result is a consequence of inappropriate reference values and the fact that the section modulus calculation does not correctly reflect the load-carrying capacity of thin-walled wooden tubes (Fig. 3).

"correct" One-Third Rule to mature urban trees, reality starts getting complicated and forces us to change our perception.

Arborists trying to practically apply the One-Third Rule quickly realize something. Compared to the common slender forest conifer with a centrally rotten zone in a stem with a more or less circular cross-section, the typical mature urban tree to be inspected in terms of safety is much more challenging (Fig. 5). We note that:

- The cross-sections of the trunks at the stem base are commonly not circular, and
- The defects are mostly not located in the center (of an irregularly shaped cross-section).

As a result, the One-Third Rule simply cannot be applied because there are hundreds of different t/R values in the same cross-section; one of them alone cannot adequately represent changes in breaking safety due to defects.

Currently, the only non-destructive way to estimate the loss in load-carrying capacity of a given trunk cross-section due to defects is by tomography. This does not mean that a sonic tomograph (patent: Rinn 1999; 2014b), with technology available from several companies, has to be applied. In many cases, a visual assessment is sufficient and the cross-section can then be "painted" manually on a smartphone for an instant determination of the loss in load-carrying capacity for all wind-load directions.

Sometimes, a resistance drill (Rinn 1988, 2012, 2016; patent: Rinn 1990) can help to assess the location and extension of voids and decayed areas more precisely. However, this only works when it is clear what the measured profiles really mean in terms of wood condition. This is not the case for many of the 20 different types of resistance drills brought to the market since 1987 by at least six different companies; for only very few of these resistance drills is a significant correlation between the obtained profiles and wood density shown (Gao et al. 2017).

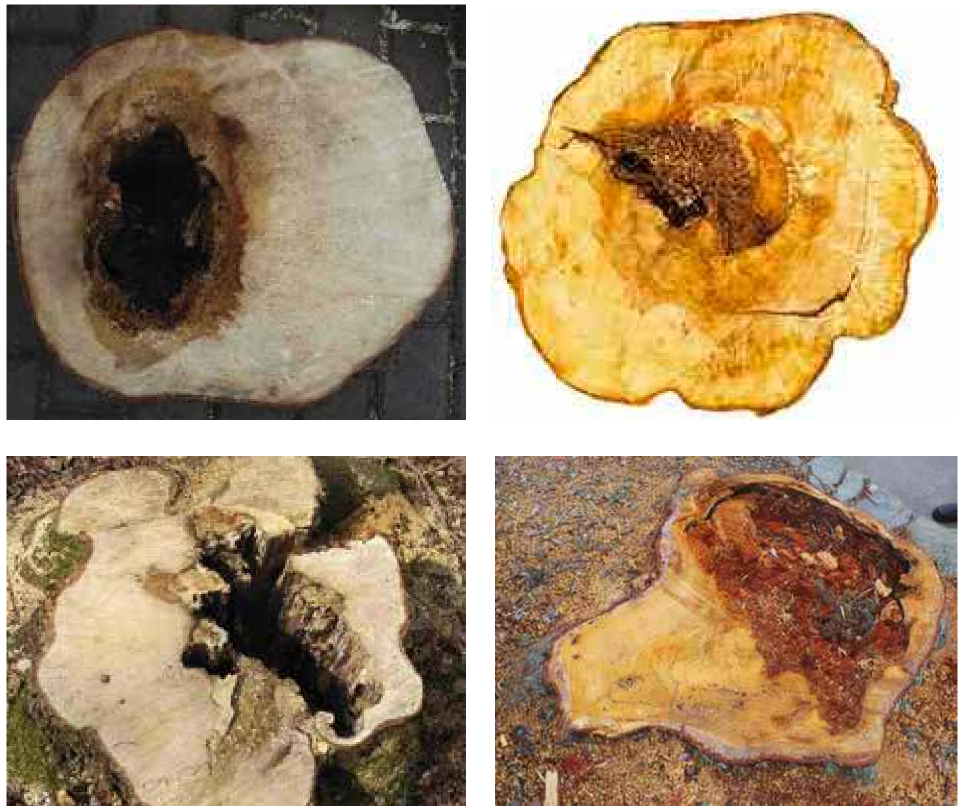


Figure 5. Examples from typical mature urban trees to be inspected in terms of safety: the cross-sections are commonly not circular and the defects are mostly located off-center. Such cross-sections provide many different radius values and many different shell-wall thicknesses (t), often ranging from zero (t=0) to fully wooded (t=Radius). Consequently, there is no typical or average t/R that could be quickly determined at the tree. Furthermore, minimum, maximum, or average t/R values do not represent the load-carrying capacity of such cross-sections. In consequence, the One-Third Rule simply does not apply to these kind of trees.

Without a significant correlation to wood density, resistance drilling profiles cannot be interpreted correctly in terms of wood condition (Rinn 2012, 2016).

Despite the fact that the SIA calculation model is wrong for thin-walled or open-tree stems (Rinn 2017; 2018a), there are some aspects of the SIA concept (Wessolly 2005) to be recognized and acknowledged. For instance, breakage safety is not only determined by the relative loss in load-carrying capacity of a cross-section but is always a result of comparing load-carrying capacity with the real load the tree is facing.

The load to a common urban tree mainly comes from wind (Rinn 2014a) and is (in first order) proportional to tree height to the power of three ($\sim H^3$). Interestingly, the load-carrying capacity of the stem cross-sections depends on their diameter to the power of three ($\sim D^3$), thus in a similar way as wind load depends on total tree height. In consequence, the ratio D^3/H^3 can be used as a rough measure for tree safety: not in absolute numbers (as wrongly practiced by SIA), but by observing relative changes of this ratio over time (Rinn 2015). The fact that trees try to keep H/D constant for decades after the juvenile growth phase (Kahle et al. 2008) can thus be interpreted as their desire to maintain a constant safety factor ($\sim D^3/H^3$) for the duration of the tree's life, which makes sense in many ways.

However, even when tree height is no longer increasing (typically 60 to 80 years of age for common urban trees), trees still annually put on girth. The continuous addition of new tree rings automatically leads to an increasing load-carrying capacity and, at the same time, to a correspondingly higher basic stability. Consequently, the older mature trees are, the higher their basic stability and the more defects they can tolerate without becoming hazardous. Taking into account these size-related (positive) aging effects allows arborists to determine the gain in safety for mature trees and thus determine what extent of "defects" can be tolerated without having an increased probability of failure.

The practical implication is that many, if not most, mature urban trees of concern have no need for pruning (for wind-load reduction) or for other expensive mitigation measures, resulting in the following benefits:

- Less money needed for pruning and cabling mature trees;
- Less damage to tree vitality and to the tree's ability to resist fungal decay; and >>

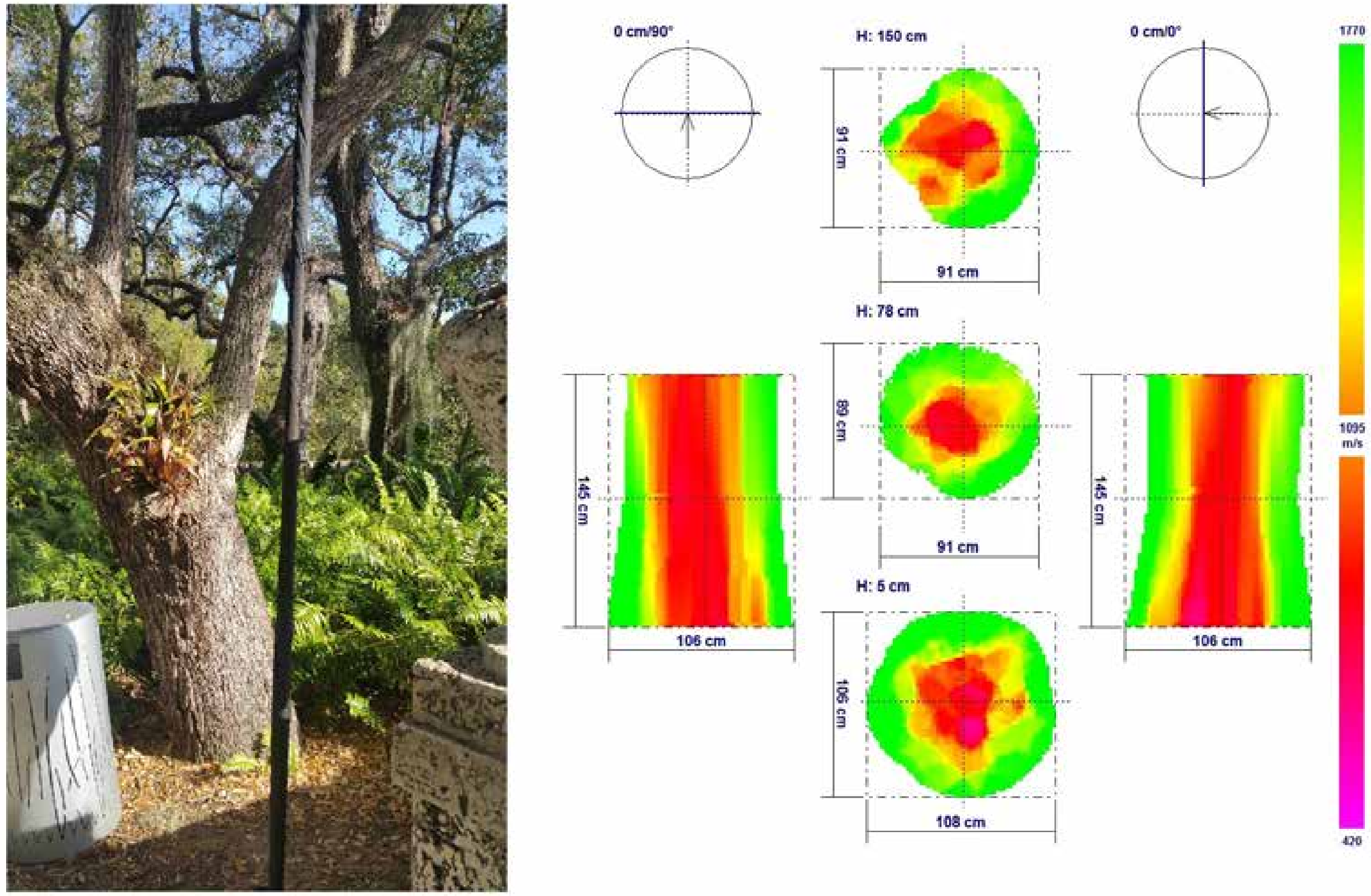


Figure 6. This tree has stood close to a subtropical coastal shore line for more than 100 years. As shown by the sonic tomogram, the stem has been severely damaged and hollow for decades but has survived dozens of hurricanes while young intact trees in the same area broke. This illustrates that the older trees are, the higher their basic safety and the more decay the can tolerate without being significantly more susceptible to breakage.

- Longer and less expensive conservation of mature and ancient trees as important natural habitats.

Taking into account this one aspect of the many allometric (quantitative relations) properties of mature trees (annually and automatically increasing basic safety as soon as height growth stops) thus helps arborists and tree-risk assessors relax at the tree: the older the mature trees are, the more they can tolerate defects. Although it may sound counter-intuitive, we have to learn and accept what nature tells us: even strongly hollowed trees can be safer than young intact trees without any defects (Fig. 6).

The One-Third Rule correctly reflects the fact that the load-carrying capacity of circular cross-sections with centrally located defects drops significantly as soon as the ratio of shell-wall thickness (t) over radius (R) goes below 1/3. That means the One-Third Rule is a valid and important aspect for understanding general properties of circular cross-sections with centrally located defects, and this can be used to evaluate breaking safety of trees in forest stands and plantations as long as they are still growing in height.

For safety assessments of the typical mature urban tree, the One-Third Rule usually cannot be applied because the cross-sections are commonly not circular and the defects are usually not located in the center. The t/R ratios of such cross-sections do not provide relevant information for determining load-carrying capacity of the corresponding cross-sections. This can be done only when applying tomographic approaches, determining the relative loss in load-carrying capacity as compared to the fully intact cross-section.

But this is only one input parameter when evaluating safety, because the load has to be regarded as well. Height and the approximate age of the tree have to be determined (or at least estimated). Doing this in absolute numbers (like SIA) can deliver worthless or even dangerous results, an example of which is shown in Fig. 4.

Realizing that the VTA One-Third Rule as described here is not applicable for most mature urban trees and that the mathematical model of the competing SIA concept is obviously wrong raises questions. How did such concepts sneak into international standards? Why do corresponding presentations dominate nearly all conferences and journals for years without data proving the claims regarding the typical mature urban tree to be inspected in terms of safety?

Understanding the scientific basics shows we should use “relative and self-referencing approaches,” looking for changes in the major allometric factors (such as tree height and diameter at breast height) over time for evaluating tree-safety. As soon as trees no longer grow in height, the wind load no longer increases, yet girth continues to increase with the corresponding gains in breaking safety.

Even tiny radial increments lead to a significant annual growth of the load-carrying capacity and thus correspondingly higher basic stability. This explains the fact that mature trees can obviously tolerate significantly more and bigger defects without being more likely to break as compared to young (and even intact) trees. Countless numbers of mature trees, hollowed out for decades but surviving strong winds, prove this as a fact.

Fortunately, the increase of the basic breaking safety (as a function of age and growth rate) as well as the loss in load-carrying capacity can be estimated using smartphone applications at the tree without need of external reference data (as used by SIA) and, in many cases, even without any advanced diagnostic technology. Applying this safety evaluation concept to mature trees in the last years led to significantly less pruning and cabling recommendation because of breakage safety concerns, which is positive in many ways: it saves money and does not further reduce the tree’s capabilities to defend against fungal decay (Boddy & Rayner 1983).

The director of the urban tree department of a German town recently wrote shortly before retiring: “After having applied this ‘new’ concept of tree-safety evaluation for several years, we kept many trees much longer than we would have done before and we spent much less money for tree care (pruning and cabling), while preserving a more natural urban environment and habitat without having more failures occur. That meant more benefits for less money.”

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Tree of Merit: Fall Fiesta Sugar Maple (*Acer saccharum* 'Bailsta')

Jennifer Jolliff is an ISA Certified Arborist who has served as a program arborist for the City of Bozeman, Montana since 1999.

The Fall Fiesta sugar maple (*Acer saccharum* 'Bailsta') is a patented cultivar selected in 1987 from a group of seedlings at Bailey Nurseries in Yamhill, Oregon. It was chosen because of its vigorous growth rate; upright, symmetrical form; and leathery leaves that are resistant to scorch and tatter caused by droughty or windy conditions, respectively.

Fall Fiesta is an excellent shade tree with a dense, rounded crown; it maintains its shape and requires little pruning. Its fall color may consist of more oranges and reds than other sugar maple varieties, and it exhibits excellent winter hardiness, from USDA Zones 3 to 8. Healthy trees don't have significant pest or disease problems.

Although it prefers a slightly acidic soil, Fall Fiesta adapts well to differences in soil pH. It doesn't, however, tolerate compacted soils or salt, and if planted in high pH soils may become deficient in manganese. It is somewhat sensitive to air pollutants. Like most trees, it grows best in moist, well-drained soils, with adequate irrigation where necessary. It prefers full sun exposure but can tolerate some shade.

Fall Fiesta has a deep, wide-spreading root system and performs best in larger planting spaces. Sugar maple is prone to root girdling, so precautions should be taken during planting to inspect stock and eliminate any circling or girdling roots.

In favorable conditions, this tree will reach a height of 60 to 70 feet (18 to 21 m) with an expected lifespan of 100 years or more. Fall Fiesta is a reliable, low-maintenance shade tree that will brighten the landscape each fall with its celebration of color.

—Jennifer Jolliff, ISA Certified Arborist, Municipal Specialist, City of Bozeman, Montana Forestry Division

Above: Fall Fiesta sugar maples at Bold Spring Nursery

Below: Fall foliage of Fall Fiesta. Photo Courtesy Missouri Botanical Garden Plant Finder