Tree risk assessment: an international overview

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Graphics and text partially taken from E. Thomas Smiley, Ph.D. Bartlett Tree Research Laboratories, Charlotte, NC USA
International standards?

- ISO 31000 & 31010 Risk Mgmt & Assessment
- ANSI A300 Standard (2010)
- ÖNORM L1122 (Kontrolle/Pflege, 2003/11)
- UK National Tree Safety Group report (in draft)
- FLL Baumkontrolle:
  - standard inspection (2006)
  - eingehende Untersuchung (draft published 2011)
- ISA BMP for Risk Assessment - 2011
- ISA Tree Risk Qualification – due 2013
- ...

Inspection / Examination

• Most standards distinguish between different levels of inspection, ranging from
  – Survey / drive-by-assessment
  up to
  – Detailed examination

• Most standards recommend detailed examination for ‘important trees’ if visual inspection cannot provide a clear result.

• Yet no standard clearly describes reliable safety thresholds, technical options and limitations.
German Situation

• VTA (t/R>1/3, H/D>50, L/D>40) ☺ ☞ SIA ☺ ☞ ... ☺ ☞ ...
• Tree to be felled if visual inspection can not ensure safety (because technical inspection too expensive and ‘dangerous’).
• Every road-side tree has to be drilled regularly (because roots could be decayed).
• Every tree has to be drilled for written proof of inspection (even intact and young trees).
• “Drilling kills trees”, both coring and resistance recording (“Autobahn für Pilze”).
• Only sonic tomography and / or pull-test accepted!
• Exclusively this device, this method, ..., accepted.
• 1. drilling => 2. sonic tomography => 3. pulling
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Common Standard?

• No!
Common Agreement on scientific basics?

• No!
Common Understanding of technical possibilities and limitations?

• No!
  (>90% checked reports wrong!)
Basic reason for this chaos?

• Most arborists and green experts can not and do not have enough education and knowledge about
  – scientific basics
    • wood anatomy and pathology
    • biomechanics
  – methodical & technical possibilities and limitations
    • application
    • interpretation and evaluation

required to build their own opinion about intense tree examination and use of diagnostic devices.
Driving factor

• Germany again a successful export-champion
  – providing theoretical and technical ‘solutions’
    (methods and diagnostic equipment)
  – combined with non-rational bull-fight-struggles

• Many ‘scientific’ presentations were&are not based on neutral research and data but following (more or less hidden) private business interests => diagnostic myths were sent out!
Obvious signs for myths

- ‘Scientists’ of public research/education institutions
  - exclusively using/describing products of one company
  - explicitly recommending products (of one company)
- Data and results not confirmed by others.
- Claims without REAL proof (‘one side of equations’).
- No publication in tough peer-review journals.
- Ignoring established standards (DIN 1319, ANSI).
- Applying thresholds derived from thin slender trees within forest stands or glass/steel tubes on mature urban trees – this can never be correct!
Solution?

• No dogmatism but open discussions (FLL/ISA).
• Neutral research and honest publications.
• Proof of every hypothesis on mature urban trees by
  – loading until failure (Fachverband 2010-)
  – continuous measurements (in wind)
• Neutral education based on science & data.
• Certification / Qualification (to be renewed)
Tree Risk Assessment:

BMP & Qualification
Standards are Interpreted by ISA BMPs
Best Management Practice for Tree Risk Assessment

• ISA Goods and Services Committee
• Finished by October 2011
• A consensus document with input from over 50 reviewers in 13 countries
Tree Risk Assessment BMP

• Basics of Risk – definitions, targets, goals
• Conducting a Risk Assessment - Levels
• Loads on trees – wind, rain, snow, ice.
• Defects to look for – 7 categories
• Response growth
• Risk Categorization – Likelihood and Consequences
• Risk Mitigation - Remedial Actions, reassessment, residual risk
• Risk Reporting
Current:
- Pruning, Utility Pruning
- Fertilization
- Support Systems
- Lightning Protection
- Construction Management
- Transplanting
- Risk assessment

Currently Ahead of ANSI:
- IPM
- Tree Inventories

In process:
- Data Standardization
- Soil Management
Purpose: To enhance and validate an individual’s proficiency with tree risk assessment.

Goals: Establish a systematic process to train and test professionals that perform tree risk assessment.
Class outline:

- Overview of Tree Risk Assessment 2.0 hrs.
- Target Assessment 1 hr.
- Site assessment 1.5 hr.
- Tree biomechanics 3 hrs.
- Survey and basic assessment 2.5 hrs.
- Advanced assessment techniques 1.0 hr.
- Data analysis and evaluation 1.5 hr.
- Risk management/abatement 1.0 hr.
- Reporting 1.0 hr.
- Total 14.5 hours

- Exam 120 questions, multiple choice and scenario, outdoor skills test

- Target date for First Program March 2013
Prerequisites:

- Candidate needs one of the following to participate in the course:
  - Certified Arborist with one recertification period in the industry (30 CEUs)
  - Registered Consulting Arborist (i.e. öbvS)
  - Registered Professional Forester
  - Board Certified Master Arborist (BCMA)
  - Fachagrarwirt Baumpflege or ETT
  - ETW + 3 years experience
  - FLL-Zertifizierter Baumkontrolleur + 3yr ex
  - ...
Qualitative or Quantitative Approach?

• Quantitative assessment estimates values for consequences and their probabilities
  \[ \text{Risk} = \text{Probability} \times \text{Consequences} \]

• Qualitative assessment uses ratings of **likelihood** and **consequences** of failure and to determine a level of risk in categories.
Levels of Tree Risk Assessment

• Level 1    Survey
  – Drive by / Walk by
• Level 2    Basic inspection
  – Visual inspection using standard tools
• Level 3    Advanced inspection
  – Areal inspection / platform / climbing
  – Root inspection
  – Used of technical diagnostics
    (not yet fully included in the training)
Steps of Tree Risk Assessment

• Site assessment
  – Target rating

• Tree assessment
  – Likelihood of failure

• Risk estimation
  – Combined table

• Report writing
  – Facts, findings, evaluation
  – Recommendations
Site Factors

- Used to evaluate the likelihood of failure, Include:
  - the history of previous failures,
  - site changes
  - wind and rain exposure (Load Factors)
Target

- Targets are people or property that could be injured, damaged or disrupted by a tree failure.
• an area where a tree or branch is likely to land if it were to fail.
• mostly defined as ~1.5 x tree height
Identify Known Targets

• Those that you can see or were told about.

• General categories:
  • 1) Static
  • 2) Mobile
  • 3) Movable
Types of Risks Trees Pose to People

• **Conflicts**
  - Allergies, Electric utility, Fruit, Fire, Insects and other animals, Lightning, Obstruction of traffic Control signs, signals and views, Pavement lifting, Road-edge trees, Thorns.

• **Tree Failures**
  - A tree failure is breakage of stem, or branches, or loss of mechanical support in the root system.
Factors Affecting Tree Strength

• Genetic properties (tree/wood)
• Individual tree characteristics and conditions
• Defects that reduce wood strength or tree structural stability
• Response (adaptive) growth
Failure occurs when stress exceeds strength (or load exceeds load carrying capacity of a structure)
Loads on Trees

• Gravity
  – Self weight, rain/snow, epiphytes, climbing, rigging

• Wind
  – Largest external force
  – Dynamic (changing) force
  – Twisting and bending
Key Defects and Conditions that can lead to tree failure
1. Dead Parts
2. Broken and Hanging Branches
3. Cracks
4. Weakly Attached Branches and Codominant Stems
5. Missing or Decayed Wood

- Internal or external decay?
- How much is too much?
6. Unusual Architecture
7) Loss of Root Support
Combination of Defects
Likelihood

• Estimated based on:

1) Likelihood of Failure
   a. Defects – factors that reduce strength
   Loads – Wind, rain, tree mass
   b. Response Growth – adaptation to weakness

2) Likelihood of Impact
   a. Target zone occupancy rate
   b. Target protection factors

Very likely, Likely, Somewhat, Unlikely
Categorizing the Likelihood of a failure.

Within the Specified Time Period (for example one / two / five years):

- **Improbable** - the tree is not likely to fail under all but extreme weather conditions.

- **Possible** - failure could occur, but it is unlikely during normal weather.

- **Probable** – failure under normal weather conditions.

- **Imminent** – failure has started or is most likely to occur in the near future, even if there is no wind or increased load.
Likelihood of Failed part impacting target

- Depends on target zone occupancy rates
- Protective factors
  - Lower branches
  - Structures
Categorizing the Likelihood of Impacting a Target

- Very Low - fully exposed but little used site, or well protected site of higher use.
- Low – fully exposed occasionally used site, frequently used, partially protected.
- Medium – frequently used fully exposed, or constant partially protected.
- High - A fixed target or high use road
## Likelihood of Failure and Impact (Table 1)

<table>
<thead>
<tr>
<th>Likelihood of Failure</th>
<th>Very Low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imminent</td>
<td>Unlikely</td>
<td>Somewhat likely</td>
<td>Likely</td>
<td>Very likely</td>
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<tr>
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Consequences of Failure

- Targets value
- Part size
- Fall distance
- Friction and Protection factors
Consequences are the effects or outcome of a tree failure.

- **Negligible** - property damage (<US$100) personal injury is unlikely.
- **Minor** - property damage possible (<US$1000). Personal injury is unlikely.
- **Moderate** - significant property damage (<US$10,000) is likely. People could be injured.
- **Severe** - High value property damage. One or more people could be injured or killed.
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<tr>
<td></td>
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Extremely - recommend that mitigation be done as soon as possible.
High risk - recommend mitigation measures be taken.
Moderate - recommend mitigation and/or retaining and monitoring.
Low risk - recommend retaining and monitoring as well as mitigation that does not include removal of the tree.
Risk Evaluation

The process of comparing the estimated risk against given risk criteria to determine the significance of the risk.

How much risk is the client willing to tolerate?
Risk Mitigation – Actions to Prevent Harm

• Pruning
• Cabling
• ...

- Move or remove the target
- Prune the tree
- Structural support
- Modify the site to improve conditions for the tree
- Remove the tree

- Pruning
- Cabling
- ...

- Arrowood Law Firm
- Family & Community Law
- Jeffrey B. Arrowood
- Attorney-at-Law
- 224-3333

- Tree art figure
Risk Reporting

• Written reports preferred
• Verbal report or work order are other options.
A written report should include:

Who and when tree was assessed?

Location or identification of the tree or trees assessed.

Inspection method used and details

Targets and consequences of the failure.

Site factors that were considered

List of observed conditions and structural defects.

Details on defects that were quantified

Risk assessment information and conclusion

Recommendations for mitigation

Residual risk information.

Recommendations for re-assessment
• Time between inspections (if not defined by law)
• Arborists should recommend an inspection frequency and state the time interval in their report.
• Ranges between one and five years.
• May be more or less frequent depending on the specific conditions and goals.
• Trees should be inspected after major storms potentially dangerous events.
Conclusions

=> Continuous education!
=> Join societies, visit conferences!
=> Read journals!
=> Keep current, but stay skeptical

Thank you for your attention!
Swelling, ridges, bulges –
Response to decay or mechanical stress
• Standard / Norm = what to do!
• BMP (best management practice) = how to do!
• > 20’000 members world wide, US, Europe, Asia
• > 25’000 certification holders, >80% renewers
• Founded 1908, Champaign, Illinois, USA, 45 on staff
• 50 regional/national chapter: USA, Europe, Asia
• Guidelines, safety rules, educational material in several different languages
• Certifications and qualifications
• Tree fund for research support
• Practical and scientific Journals
• ISA Board of Directors (15 international experts)

  – President Colin Bashford, England

  – Terrence Flanagan, Melinda Myers, Ward Peterson, Michael Marshall, Michelle Mitchell, Brian Phelan, Geoff Kempter, Paul Ries, Paul Jones, Zhu Ning (USA)

  – Francesco Ferrini (Italy), de Gourét Litchfield (Sweden), Mark Roberts (New Zealand), Frank Rinn (Germany)