New standard for the **static load test method** and its principles

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The members of the expert group Sachverständigen-Arbeitsgemeinschaft (SAG) Baumstatik e.V. have developed a standard which describes the static load test method for the structural assessment of trees and made it publicly available.

The standard was developed for two primary reasons. First, it is intended to provide an internal SAG agreement in which the requirements for the application, evaluation and presentation of tree static load tests are summarised. Secondly, the standard has been made available as a technical guidance document outside the SAG Baumstatik group to enable arboricultural experts, private customers, landowners and public bodies to be able to reference a document that sets out appropriate procedures for applying the static load test method to tree assessment.

Static load tests, also known as the pulling test method, have been applied for over 35 years to reliably assess the rooting stability and stem fracture safety of trees (Wessolly & Erb, 2016; Sinn, 2022). The test



Kaspar's Oak, retained after static load text method was used. (Andreas Detter)

involves applying an accurately measured load to a subject tree, exerting a bending moment on the stem and an inclination at the stem base. The accurately measured reactions of the tree to this test load are strictly limited, within known thresholds, so that the test can confidently be described as non-destructive. A wind-load analysis determines a bending moment that might be expected to be experienced in the subject tree during a chosen extreme event, and the test data is extrapolated to estimate safety factors for stem fracture and anchorage of the root system.

Testing has become a routine method of detailed tree assessment in many countries, especially across Europe. Expert reports based on the results are requested by private customers as well as companies, landowners and authorities responsible for the management of trees and these assessments have allowed the confident retention of important trees that other methods have often erroneously identified as dangerous. Where local authorities and public bodies are concerned, tenders are often issued in accordance with public procurement guidelines. However, until now no technical standards or guidelines have been available for those bodies to reference that set out the requirements for an appropriate application of the static load test method.

Developing the standard

SAG Baumstatik's standard summarises the professional and technical requirements for carrying out static load tests, agreed by the members of the group. This international association of tree experts has been in existence for over 30 years and is dedicated to sharing the collective experience of its members in the application of tree statics methods to the assessment of the structural condition of trees. The aims of the group are both to further its members' knowledge of tree statics and to promote the recognition of statics-integrated methods by disseminating information and making important findings more widely available, beyond the group.

Over the last 15 years in particular, the method has been continuously developed through regular dialogue within the organisation and the principles of the approach have been verified and refined through hosting over 20 workshops. These have included one-day and multi-day seminars with well-respected international speakers including Ken James, Rolf Kehr, Karl Niklas, Bodo Ruck, Andreas Roloff, Steffen Rust and Hanns-Christof Spatz.

The workshops have also involved practical sessions including investigations into the anchorage failure of trees as well as on measurements using georadar and on how to approach estimating the stability and fracture safety of leaning trees using the static load test approach. In addition, conferences have been arranged with the participation of several international scientists, each



focussing on the biomechanics of trees, the effects of wind or climate change on trees in urban environments and, most recently in 2024, stem tomography.

The 62 members of the SAG Baumstatik group are now active in 13 different countries. They use the static load test method as part of their expert work, using equipment from different manufacturers and applying a number of evaluation methods. The group is the oldest and largest association of international experts in this specific field, with a level of expertise and insight into the method that puts the body in the prime position to take on the responsibility for publishing a standard.

Why is a standard needed?

The technical requirements that should be placed on this method, the potential consequences of incorrectly performed static load tests and the importance of properly defining appropriate expert services are outlined in an article in the German Yearbook of Arboriculture (Detter et al., 2022). Neither the German tree inspection guidelines of the FLL (Research Association for Landscape Development and Landscaping, 2013) nor the new European standard for tree inspections (European Arboricultural Council, 2023) provide sufficiently verifiable benchmarks for the proper application of the static load test.

Carrying out a static load test without sufficient familiarity with the method has the potential to cause damage to the subject tree and to generate data that is either inappropriate in relation to the model being applied or that could be incorrectly evaluated, resulting in significant errors in the conclusions and recommendations for tree management that are offered on the basis of the test. This can be easily avoided if the method is applied by an appropriately experienced consultant. Not doing so has the potential to undermine the integrity of the method and diminish the confidence that clients and experts can have in the results. A proper definition of the required expert services is particularly important for public clients who are issuing invitations to tender and making requests for quotations. These bodies can now use the new SAG standard for the static load test to obtain comparable offers and to effectively recognise differences in quality and competence. The standard can be referenced as a reliable technical guideline for the method, even if the document does not have the status of a national or European standard.

The SAG standard was undertaken with the brief that the document was not intended to be treated as a comprehensive manual on how static load tests should be carried out, nor was it intended to replace a regime of training or a level of experience or professional development that being an active member of the SAG Baumstatik group confers. The document merely defines the minimum requirements for carrying out the static load test and evaluating the data collected.

Examples accompany many of the requirements set out in the standard and are included in order to define procedures as reliable or to clarify why certain practices are considered reliable and why other approaches risk unreliable outcomes. The aim of the document is not to prohibit or limit approaches but to set out why particular practices are only appropriate in certain situations.

The standard is based on the collective experience of the members of the SAG Baumstatik group in applying the method and it also draws on scientific papers and specialist articles that are relevant to the subject. The content and structure of the document were developed over four years in the course of several workshops and numerous meetings of five working groups. The standard was then finalised by a smaller committee and adopted by resolution of the annual general meeting of the SAG Baumstatik group in November 2023.

The standard's approach

Whilst the standard aims to highlight unreliable, inappropriate, uninformed, unprofessional and flawed approaches to assessing trees using the static load test method - that is, approaches that do not adhere to the basic criteria considered appropriate for generating robust results and recommendations - a deliberate position was taken by the members of the group that the guidelines should be open and inclusive and should not exclude reasonable alternative approaches or suppress innovative developments in engineering-based approaches to tree assessment. Consequently, the tone and language used through the standard have been chosen with the aim of covering all relevant engineering approaches to conducting static load tests and to include any expert, equipment manufacturer or software developer working to the minimum criteria proposed in the standard for a reliable assessment of stability and resistance to failure.

According to convention, certain terms have been used to distinguish between mandatory requirements, recommendations and desirable proposals. Normative statements and examples of the issues addressed are intended to further explain the content. The application of the static load test method requires qualified judgements and experiencebased decisions. If the results are to be considered reliable, this requires users to have a comprehensive background knowledge, a deep understanding of the model used, knowledge of a range of disciplines other than tree care itself and a great attention to detail. This is reflected in the structure of the standard which is presented in five sections:

Competence and qualifications
The static load test



The SAG standard provides technical guidance for conducting static load tests. (Andreas Detter)

The wind load analysis
Evaluation of the data
Presentation of the results

A static load test can provide recommendations for the management of a tree with a relatively high level of confidence in comparison to other methods of tree assessment. However, the level of detail provided by this method is not always necessary or justifiable in relation to the level of effort and cost involved, or in relation to the nature of the issue being investigated. There are also rare scenarios when applying this method is not logistically possible or where the data collected cannot be reliably evaluated within the available models.

In putting together the standard, the group decided to focus on clearly setting out the limitations of the method and the models behind it to ensure that the test is applied appropriately, to maintain confidence in the approach and to protect the integrity of the method. Because the SAG standard openly sets out these limitations, and refers to best practice to address these issues, the document can be considered to be a reference against which clients, experts or other interested parties can independently judge whether criticisms or questions levelled at the approach have any reasonable basis.

The SAG standard for static load tests is currently available to interested specialists in both English and German at **www.sag-baumstatik.org** and can be used if a neutral reference is required for the tendering, execution and verification of tree assessments using the static load test method.

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