



European
Tree
Technician

MANUAL
for Training
and Certification
- Appendices

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Editor: Beata Pachnowska (PL)

Authors: Beata Pachnowska (PL), Paulina Sanecka (PL), Piotr Tyszko-Chmielowiec (PL), Daniel Daggfeldt (SE), Peter Hjelmqvist (SE), Christian Nørgård Nielsen (DK), Robert Oetjen (EE), Aino Mölder (EE), Kamil Witkoś-Gnach (PL), Julia Kończak (PL), Willem van Delft (NL), Wim Peeters (BE), Bregt Roobroeck (BE)

Consultation (working group): Junko Oikawa-Radscheit (EAC), Aija Livmane (LV), Baiba Piekusa (LV), Ben Bergen (BE)

Contributing Consultation: Harold Schoenmakers (NL), Simon Richmond (UK, AA), Eva Adelman (DE), Wolfgang Gross (EAC)

Project Manager: Aija Livmane (LV)

Photos and Illustrations: Paulina Sanecka (PL), or as indicated next to the figure

Graphic Design and Lay-out: Paulina Sanecka (PL)

English Proofreading: John Whitmore (LV)

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Challenges Identified in the Survey Conducted during the Project

In a survey conducted by the Erasmus+ project across Europe in 2022, respondents from different fields of arboriculture identified key challenges for the industry. These included current issues and those that will need to be faced within the next 10 years. One of these challenges is the question of how to integrate ETTs more actively into the processes of tree development and maintenance in urban areas. This is particularly important as there is a clear expectation of the importance of ETTs increasing in the next decade, especially in the context of climate challenges, ecosystem challenges, quality level expected in the industry and communication with policy makers and regulators at different levels.

Table. The challenges for the arboriculture branch

THE AREAS INDICATED BY REPRESENTATIVES OF THE BRANCH IN QUALITATIVE INTERVIEWS.	% OF RESPONDENTS INDICATING THE CHALLENGE AS IMPORTANT	
	TODAY	IN THE NEXT 10 YEARS
To convince policymakers based on objective data that planting and managing trees are an investment in ecosystem services (also economic ecosystems) and not a cost.	83%	90%
Establish tree management based on optimising the ecosystem services that trees can provide and lowering potential tree crisis.	74%	86%
Tree-site (construction) that meets the needs of trees fully, considering climate change.	77%	86%
Ensuring a good quality level of staff in arboriculture by certification processes and/or updating qualifications.	79%	88%
Bring the theoretical and practical level concerning tree work closer to each other.	73%	72%
Implement new data registration and analysing technology in assessing and managing trees.	59%	75%
Include ETTs as an obligatory partner for developing and managing an urban (tree) area.	58%	73%

Source: Beata Pachnowska. The report of online research conducted in 2022 in ETT 2020 Project Erasmus+ "European Tree Technician (ETT) image, competency expectations towards education and certification processes, evaluation of new structure and content of competencies set, in the context of contemporary and future challenges in arboriculture".

An Example of an ETT Candidate Registration Form

CANDIDATE REGISTRATION FORM
EUROPEAN TREE TECHNICIAN (ETT) EXAM
<i>Certification Center details</i>
Place, date

- I declare that I would like to register and be a candidate in the ETT exam in date/ place*
- I agree that all the details and data below will be processed for the exam procedures according to the GDPR and EAC rules by *Certification Center*.

.....
Signature

PERSONAL DATA AND CONTACT DETAILS *)	
First name/s	
Surname/s	
Date of birth	
Phone	
E-mail	
Country of origin	
Native language/s	

EDUCATION LEVEL *)	
Professional title/ academic title	
Completed field of the study/ educational establishment	

Sending the form is tantamount to consent to the storage and processing of personal data for the purposes of the exam (in accordance with the Act of 10.05.2018 on the protection of personal data and in accordance with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27.04.2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (GDPR)). DP processor/s will be ETT CC details.

ENTRY CONDITIONS (rule 6.1) *

NOTE: To register for the ETT examination, you have to answer YES to at least one of Points 1,2,3 of the ENTRY CONDITIONS. Please remember that points 2 OR 3 have to be accepted by the certification centre.

1. I am a certified European Tree Worker (rule 6.1.1)		<input type="checkbox"/> yes	<input type="checkbox"/> no
if yes:	ETW ID No.....	Valid till:/.....	
	the number of years of practical experience in an arboriculture related industry (in total) (3 years+)***(rule 6.1.3)		

OR

2. I have other certification/s or diploma/s in a tree related industry (rule 6.1.2)		<input type="checkbox"/> yes**	<input type="checkbox"/> no
if yes:	Please indicate title/ID/year of certification/s and/or diploma/s and give a short description***)		
	Number of years of practical experience in an arboriculture related industry (in total) (3 years+)***(rule 6.1.3.)		

OR

3. I have no ETW, nor other certification/s or diploma/s in tree-related industries, but I would like to register for the ETT examination, and I am able to prove my knowledge, skills and experience to be eligible for the examination (rule 6.2).		<input type="checkbox"/> yes**	<input type="checkbox"/> no
if yes:	Please explain (why are you eligible for the examination) AND indicate the title/ID/year of OTHER certification/s and/or diploma/s and shortly describe them. ***:		
	Number of years of practical experience in an arboriculture related industry (in total) (5 years+)***(rule 6.2)		

OTHER RULES CONFIRMATION (NECESSARY TO REGISTER)		
A. I agree to pay the examination fee as agreed in the project even if I fail my exam (rule 2.7).	<input type="checkbox"/> yes*	<input type="checkbox"/> no
B. I agree to pay the examination fee in the event my absence during the examination will be unexcused (rule 2.8).	<input type="checkbox"/> yes*	<input type="checkbox"/> no
C. My name may be published on the EAC website after the exam (rule 2.9)	<input type="checkbox"/> yes*	<input type="checkbox"/> no
<i>C1. On which countries' ETT lists would you like to publish your name after certification?</i>	(WRITE IN)	
D. I agree to sign the EAC Code of Ethic	<input type="checkbox"/> yes*	<input type="checkbox"/> no
E. I declare my language (written and spoken) is fluent enough to take the exam in language with language speaking examiners (rule 2.10)	<input type="checkbox"/> yes	<input type="checkbox"/> no**
<i>If no:</i>	<i>Please describe what language/s you would prefer to use during the exam</i>	

*)required

**)please wait for the acceptance of your registration

***)please be prepared to show credentials or other evidence of education or experience upon demand of the exam team.

References - Sources for Trainers

1.1. The Outputs of the Erasmus+ ETT 2020 Project

Available on EAC website <https://www.eac-arboriculture.com>.

- ETT Study Guide
- ETT Manual for Training and Certification
- ETT Exam Matrix (or Competence Matrix)
- ETT Curriculum officially launched in January 2024

1.2. ETT or other related aspects of arboriculture

- <https://www.eac-arboriculture.com/eac-intro.aspx>
- <https://www.eac-arboriculture.com/ett-intro.aspx>
- <https://vetree.eu>
- <https://vetcert.eu>
- <http://tree-assessor.dobrekadry.pl>
- <http://www.europeanarboriculturalstandards.eu>

1.3. Resources related to training and exams methodology

- <https://europa.eu/europass/en/europass-tools/european-qualifications-framework>
- <https://trainingindustry.com/wiki/strategy-alignment-and-planning/training-process-framework/>
- <https://searchcio.techtarget.com/definition/learning-management-system;>
- <https://icehrm.com/blog/how-to-conduct-an-effective-training-and-development-process-in-your-organization/>
- <https://simplifytraining.com/article/how-to-conduct-an-effective-training-session/>
- <https://www.igi-global.com/dictionary/broadcast>
- <https://cndls.georgetown.edu/atprogram/twl/teaching-as-process/>
- <https://tips.uark.edu/using-blooms-taxonomy/>
- <https://www.yourarticlelibrary.com/training-employees/training-of-employees-types-methods-assessment-and-evaluation/69316>
- <https://xpertcube.com/types-of-lms/>
- https://en.wikipedia.org/wiki/Learning_management_system
- <https://www.ispringsolutions.com/blog/what-is-lms?utm>
- <https://elearningindustry.com/directory/software-categories/learning-management-systems>
- <https://elearningindustry.com/top-skills-every-lms-admin-should-have>
- <https://www.cambridgeenglish.org>

- Journal of Education and Practice www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.6, No.19, 2015
- <https://online.hbs.edu/blog/post/benefits-of-management-training>
- <https://www.onlineassessmenttool.com/knowledge-center/assessment-knowledge-center/what-are-the-types-of-assessment/item10637>
- <https://www.wtamu.edu/student-support/career-services/exploration/stu-evaluating-skills.html>
- <https://www.worldbank.org/en/topic/skillsdevelopment#1>
- <http://www.goodluckexams.com/types-of-tests/>
- <http://faculty.academyart.edu/faculty/teaching-topics/teaching-curriculum/enhancing-teacher-student-interaction/different-types-questions-blooms-t>
- <https://www.algonquincollege.com/dlekb/kb-info/question-types-when-to-use-them/>
- <https://www.wtamu.edu/student-support/career-services/exploration/stu-evaluating-skills.html>
- <https://lo.unisa.edu.au/pluginfile.php/1687816/>

Detailed programmes of the training/syllabuses of chosen topics

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Syllabus related to Study Guide chapter 1.1.2.....	15
Syllabus related to Study Guide chapter 1.5.1.....	18
Syllabus related to Study Guide chapter 1.5.2.....	21
Syllabus related to Study Guide chapter 1.6.2.....	28
Syllabus related to Study Guide chapter 1.2.1.....	29
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Syllabus

related to Study Guide Chapter 1.1.1

<p>Training: Foundations of Tree Management Subject: Tree Function and Structure Total Hours: 40, including 12 hours on-site learning, and 28 hours independent study.</p>	
<p>Short description of the training subject: The subject covers the fundamentals of tree morphology, anatomy, and physiology. The subject also includes the role and importance of phytohormones as well as the defence mechanisms of trees. The important interrelationship of trees with their environmental factors is also described. This knowledge is the basis for choosing the right tree care techniques to ensure the good health and long life of trees.</p>	
<p>Educational objective: Knowledge of tree morphology, anatomy, and physiology is a prerequisite for learning the material in the following chapters: planting, site selection, visual tree assessment and hazard analysis, tree care and remedial operations. It is useful to study this topic simultaneously with Chapter 1.1.2 Tree development and Growth Stages.</p>	
<p>Key terms: <i>tree architecture, stem, crown, habit, roots, plasticity, leaves, branch, twig, branch union, branch collar, branch bark ridge, included bark, central leader, co-dominant stem, apical bud, axillary bud, adventitious shoots, absorbing roots, root hairs, root tip, root cap, cell, tissue, bark, cork cambium, phloem, xylem, sapwood, heartwood, pith, medullary rays, primary meristem, secondary meristem, annual growth, annual ring, adventitious bud, photosynthesis, respiration, transpiration, assimilates, energy, phytohormones, defence system of a tree.</i></p>	
<p>Educational outcome(s):</p>	
<p>Knowledge: The student knows about:</p>	<p>Skills: The student is able to:</p>
<ol style="list-style-type: none"> 1. the basics of tree biology and their relevance to modern arboricultural practice; 2. external features (morphology) of trees; 3. the anatomical and physiological features and functions of the tree; 4. the lateral branch to trunk union, and describe how pruning techniques must be adapted to this feature; 5. the processes of callus and wound-wood production as a response to injury; 6. the main defence mechanisms of the tree with reference to injury, including compartmentalisation; 7. the influence of environmental factors on tree physiological processes; 8. root plate architecture and morphology and how it affects the stability of trees; 9. rooting patterns; 10. crown structure, wind-sail factors, and crown balance; 11. the impact of co-dominant stems and multiple stem attachments on the biomechanics of trees. 	<ol style="list-style-type: none"> 1. identify different species of tree based on their external features; 2. analyse good and bad techniques of branch removal based on visible features of branch union and response to damage (pruning cut, breakage, etc.); 3. show the defence principles at work in different tree and wood samples; 4. assess the stability of a leaning tree based on its root-plate condition and show elements of root-plate architecture on a wind-fallen tree; 5. assess the stability of a tree based on crown structure, wind-sail factor and balance.

Teaching Methods	
Lessons are divided into on-site (12 hours), and independent study (28 hours) using books, online materials and other sources. The on-site lectures will be divided into introductory lectures (4 hours), field work (4 hours) and summary lectures (for review, feedback and evaluation) (4 hours).	
Key issues: In the course of the studies, an overview will be provided of tree morphology, tree anatomy, and tree physiology. In the course of the field study, attention will be paid to the following: observation of the crown and root architecture of different tree species, branch unions, wind-sail factor and the defence system of trees. Students will train themselves to assess the tree's stability based on its rootplate condition, crown structure, and wind-sail factor.	
Required equipment and teaching aids – specific for this teaching area Transport for excursions, suitable clothing for outdoor work, microscope (>50X), increment borer, samples, photos.	
Evaluation (see ANNEX 1):	<ol style="list-style-type: none"> 1. Combined test (multiple choice and open questions) 2. Applied exercises
Authors: Aino Mölder and Robert Gustav Oetjen, Luua Forestry School	
<p>Sources for independent learning</p> <ol style="list-style-type: none"> 1. ETT Study Guide Chapter 1.1.1 Tree function and Structure 2. Andrew D. Hiron and Peter A. Thomas. Applied Tree Biology. https://vdoc.pub/documents/applied-tree-biology-35aneks5li50 3. Dirk Dujesiefken and Walter Liese. The CODIT Principle. Implications for Best Practices. ISA, 2015 4. Dirk Dujesiefken, Neville Fay, Jan-Willem de Groot, Nigel de Berker: Trees – a Lifespan Approach. Contributions to arboriculture from European practitioners: http://drzewa.org.pl/en/publikacja/trees-a-lifespan-approach-contributions-arboriculture-from-european-practitioners/ 5. EAC. European Tree Worker. Patzer Verlag, 2015 6. Ed.F.Gilman. An Illustrated Guide to Pruning. Third edition. Delmar (USA), 2012 7. Piotr Tyszko-Chmielowiec. Elementary tree biology, ecology and biomechanics. A manual for tree assessors and arborists. http://tree-assessor.dobrekadry.pl/wpcontent/uploads/2021/12/Biology_OST_EN_08_12_2021_S.pdf 8. Duncan Slater. The Anatomy and Biomechanical Properties of Bifurcations in Hazel (<i>Corylus avellana</i>). A thesis submitted to the University of Manchester for the degree of DOCTOR OF PHILOSOPHY in the Faculty of Life Sciences, 2015. 9. https://www.britannica.com/plant/tree/Tree-structure-and-growth 10. Boddy, Lynne, 2021, Fungi and Trees. Arboricultural Journal 11. https://www.forestresearch.gov.uk/documents/5318/7111_FC_Urban_Tree_Manual_V15.pdf 	

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from Chapter 1.1.1 of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the best choice:

- When felling a tree, the trunk layers are penetrated in the following order: (b)
 - bark, cambium, phloem, sapwood
 - bark, phloem, cambium, sapwood**
 - bark, cambium, heartwood, sapwood
 - bark, phloem, sapwood, heartwood.
- If the apical bud is removed, then: (a)
 - lateral buds will start to develop**
 - flowering and fruit production will increase
 - lower lateral buds will dry out
 - nothing notable will happen.
- The part of a tree's root system where the highest level of absorption takes place is located in: (a)
 - the uppermost 30-cm-thick soil layer**
 - the soil layer deeper than 50 cm
 - inside the crown's dripline
 - attached to the taproots.
- The structure, or group of cells, that helps prevent spread of discoloration and decay from a branch into the trunk is called (d)
 - branch bark ridge
 - growth ring
 - heart wood
 - branch protection zone.**
- Which mechanism of a tree's self defence is responsible for preventing decay from spreading into new wood produced after injury? (d)
 - reaction zone formed by the plugging up of vascular tissues
 - reaction zone formed by annual rings
 - reaction zone formed by medullary rays
 - barrier zone created by the cambium.**

Answer the open questions

- Differentiate between the crown and root formations of a tree growing in an open urban environment and the same tree species growing in the forest. Why are these so different?
- Describe the movement of water and photosynthates within the tree.

Exercises:

- Over the winter, hares chewed off the bark of a young tree around its entire circumference. What is the survival perspective for this tree? Justify your opinion.
- A paved sidewalk was built in a park. The designer placed the trench for the sidewalk to be dug 50 cm from the tree trunks. In your opinion, was the project prepared correctly? Justify your opinion.

Syllabus related to Study Guide chapter 1.1.2

Training: Foundations of Tree Management
Subject: 1.1.2. Tree Development and Growth Stages
Total Hours: 40, including 8 hours on-site learning, and 32 hours independent study.

Short description of the training subject: The subject covers the fundamentals of tree development and growth stages. The chapter explains the concepts of growth and development and their special features at different stages of a tree's life cycle. An overview of the physiological basis of growth and development is also given.

Educational objective: Each tree needs specific management techniques at different stages of its life cycle. The acquired knowledge is the basis for choosing a reasonably suitable management method. In this way, it is possible to ensure the good health and long life of the trees. Knowledge of tree growth and development is a prerequisite for learning the following chapters: pruning, visual tree assessment and hazard analysis, and tree care and remedial operations. It is useful to study this topic simultaneously with the Chapter 1.1.1 Function and Structure of Trees.

The key terms are: *apical dominance, apical growth, crown architecture, cumulative growth curve, gigantism, lateral growth, modular structure, reiteration, ageing process, ARCHI method, carbohydrate balance, death, differentiation, functional units, growth rates, linear progression, life cycle, life expectancy, life stages, morpho-physiological model, regeneration, modularity.*

Educational outcome(s):

Knowledge: The student knows:	Skills: The student is able to:
<ol style="list-style-type: none"> 1. the principal areas of growth and development in a tree; 2. how to identify the different development stages of a tree; 3. the architecture of trees and sees their potential future development; 4. how to explain the differences in development and growth stages; 5. the evaluation criteria based on these stages to describe maintenance and remedial measures. 	<ol style="list-style-type: none"> 1. give an assessment of the tree's development phase based on visual observation; 2. predict the future development of the tree based on the tree's crown architecture; 3. establish evaluation criteria based on these stages to describe maintenance and remedial measures.

Teaching Methods

Lessons are divided into on-site (8 hours) and independent study (32 hours) using books, online materials and other sources. The on-site lectures will be divided into introductory lectures (2 hours), field work (4 hours) and summary lectures (for review, feedback and evaluation) (2 hours).

Key issues: The concept of growth. Modularity as growth patterns. Growth curve. Concept of development. The ageing process. Tree development at different life stages. Regeneration as part of the tree life stages.

Required equipment and teaching aids: Park or green area with different tree species. Binoculars.

Evaluation (see ANNEX 1):

3. Combined test (multiple choice and open questions)
4. Exercises and simulations

Authors: Aino Mölder and Robert Gustav Oetjen, Luua Forestry School

Sources for independent learning

1. ETT Study Guide Chapter 1.1.2 Tree Development and Growth Stages
2. Piotr Tyszko-Chmielowiec. Tree Assessor. **Elementary tree biology, ecology and biomechanics. A manual for Tree Assessors and Arborists.** Wroclaw, 2021. http://tree-assessor.dobrekadry.pl/wp-content/uploads/2022/07/04_Elementary-tree-biology-ecology-and-biomechanics.pdf
3. Dirk Dujesiefken, Neville Fay Jan-Willem de Groot, Nigel de Berker. **Trees – a Lifespan Approach. Contributions to arboriculture from European practitioners.** <http://drzewa.org.pl/en/publikacja/trees-a-lifespan-approach-contributions-arboriculture-from-european-practitioners/>
4. David Lonsdale (ed.) **Ancient and other Veteran Trees: further guidance on management.** The Tree Council, London 2013. http://ancienttreeforum.co.uk/wp-content/uploads/2015/02/ATF_book.pdf
5. EAC. European Tree Worker. Patzer Verlag, 2015
6. Cristopher L. Brack and Geoffrey B. Wood. **Tree Growth and Increment.** The Australian National University, Canberra, 1997.
7. https://fennerschool-associated.anu.edu.au/mensuration/BrackandWood1998/T_GROWTH.HTM

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from chapter 1.1.2 (Tree Development and Growth Stages) of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the right choice:

1. The growth of a tree means: (d)
 - a. tree height increment
 - b. increase in tree diameter
 - c. increase in wood mass, both of the above-ground and below-ground parts of the tree
 - d. all the answers given above are correct**
- 2) The cumulative growth curve (CGC) characterizes: (b)
 - a. total increment of all parts of the tree in 1 year
 - b. total increment of all parts of the tree from its birth to the death**
 - c. the average volume, which is obtained by dividing the volume of the tree by its age
 - d. the height of the tree that it has reached at the end of its life
- 3) The development of a tree means: (d)
 - a. the sequence of qualitative morphological and physiological changes within all lifetime of the tree
 - b. the changes in the shape and function of the plant's parts
 - c. the process initiated by the differentiation of cells that have undergone the cell division and elongation phases
 - d. all the answers given above are correct**
- 4) The growth and development of a tree depend: (d)
 - a. on implementation of appropriate and correct tree care measures
 - b. on its genetics
 - c. on its growing environment
 - d. both on genetics and growing environment**
- 5) What is the physiological cause of the mortality of an old tree? (c)
 - a. the tree has reached its biological age
 - b. due to xylem damage, transpiration is disturbed, and this leads to the decline of the tree
 - c. carbon starvation and hydraulic failure to the extent that it can no longer support basic metabolism (eg., respiration, transpiration) and defence against external influences**
 - d. the tree has not been maintained properly

Answer the open questions

- 1) Explain the differences between the cumulative increment and the current annual increment of a tree.
- 2) What is the carbon starvation of an old tree, and why does it happen?

Exercises:

1. Based on an observation, determine the phase of the life cycle of a tree.
2. Simulation: Describe appropriate tree care and soil improvement measures based on the tree's health and life cycle phase.

Syllabus related to Study Guide chapter 1.5.1

Training: Foundations of Tree Management Subject: Diagnostic features Total Hours: 24	
Short description of the training subject: This training focuses on the identification, assessment, and evaluation of diagnostic features found on trees and within their environments.	
Educational objective: The educational objective of this training is to impart a comprehensive understanding of various diagnostic features on trees and within their surroundings, enhancing participants' skills in their identification, assessment, and evaluation. It aims to foster an understanding of these features' implications on tree health and build participants' ability to predict potential changes and their likely impact.	
The key terms are: <i>biodiversity, cankers, cavities, codit, compensatory growth cracks, deadwood, diagnostic features, dry branch, fungi, frost cracks, fungal fruiting bodies, growth stage, habitat, hollows, insects, ivy, lightning strips, microorganism, necrosis, nest, pruning wounds, reaction wood, reiterations, reiteration, root system, sunburn, surface injury, tree adaptation, tree biomechanics, tree ecosystem, tree microhabitats, weak fork, wood decay, wound wood.</i>	
Educational outcome(s):	
Knowledge: Student knows:	Skills: Student is able to:
<ol style="list-style-type: none"> 1. what a diagnostic feature is and its significance in assessing the condition of trees; 2. the identification and evaluation methods for typical diagnostic features; 3. the relationship between a diagnostic feature and its significance for the condition and stability of a tree or its parts; 4. the influence of the observed diagnostic feature on safety; 5. about compensatory growth and its importance for the assessment of diagnostic features 	<ol style="list-style-type: none"> 1. accurately identify and define diagnostic features in trees and understand their significance in tree assessment; 2. apply various methods for identifying and evaluating typical diagnostic features; 3. explain the relationship between specific diagnostic features and their impact on the condition and stability of a tree or its parts; 4. assess the safety implications of observed diagnostic features, including potential risks; 5. recognise and understand compensatory reactions in trees in response to various environmental stresses or damages.
Teaching Methods	
<ul style="list-style-type: none"> - Lectures focusing on the effects of various diagnostic features on the condition of trees including discussion on common issues and observations (8 hours). - Case study to present real-life scenarios to explain the connection between diagnostic features and tree health and stability (8 hours). - Field exercise to identify different diagnostic features on trees (8 hours). 	
Key issues: Recognition of diagnostic features, assessment of diagnostic features; interpretation and assessment of compensatory growth, features in relation to tree's development phase and species specifics	
Required equipment and teaching aids: Exhibits with various diagnostic features Inspection forms Trees in the field (various species, age, condition) - for field exercises	

Probe and mallet Binoculars	
Evaluation:	<ol style="list-style-type: none"> 5. Combined test (multiple choice and open questions) 6. Exercises and simulations
Authors: Kamil Witkoś-Gnach, Julia Kończak, Instytut Drzewa	
Sources for independent learning	
<ol style="list-style-type: none"> 1. ATF (2008). <i>Ancient Tree Guide No. 4: What are ancient, veteran and other trees of special interest?</i> Ancient Tree Forum, c/o The Woodland Trust, Grantham. 2. Boddy, L. (2021). <i>Fungi and Trees. Their Complex Relationships.</i> Arboricultural Association, Stonehouse. 3. Dujesiefken, D. Jaskula, P. Kowol, T. Lichtenauer, A. (2018). <i>Baumkontrolle unter Berücksichtigung der Baumart. Bildatlas der typischen Schadsymptome und Auffälligkeiten. 2., Überarbeitete und erweiterte Auflage,</i> Haymarket Media, Braunschweig. 4. Dujesiefken, D. Liese. W. (2015). <i>The CODIT - Principle - Implications for Best Practices.</i> International Society of Arboriculture, Champaign, Illinois. 5. Dunster, J. A.; Smiley, E. T.; Matheny, N.; Lilly, S. Book. (2017). <i>Tree risk assessment manual 2017,</i> ISA. 6. Hirons A., Thomas P. (2018). <i>Applied Tree Biology.</i> Wiley, Oxford. 7. Humphreys, D., Wright, C. (2021). <i>Fungi on Trees. A Photographic Reference.</i> Arboricultural Association, Stonehouse. 8. Humphrey, J. & Bailey, S. (2012). <i>Managing deadwood in forests and woodlands. Forestry Commission Practice Guide.</i> Forestry Commission, Edinburgh. 9. Lichtenauer, A., Kowol, T., Dujesiefken, D. (2011). <i>Pilze bei der Baumkontrolle.</i> Haymarket Media, Braunschweig. 10. Matheck C., Bethge K., Weber K. (2015). <i>The Body Language of Trees. Encyclopedia of Visual Tree Assessment.</i> Karlsruhe Institut of Technology. 11. Spatz, H.-Ch. (2013). <i>Zur Stabilität hohler Bäume. W: Deutsche Akademie für Sachverständige Grün (Hrsg.): Tagungsband Gehölzsymposium 2013 Hannover. 224-232.</i> 12. Strouts R.G., Winter, T.G. (2014). <i>Diagnosis of ill-health in trees.</i> Arboricultural Association, Stonehouse. 13. Tyszko-Chmielowiec, P., Kujawa. A. (2021). <i>Fungi on trees for tree inspectors.</i> Instytut Drzewa, Wrocław. 14. Watson, G., Green, T. (2011). <i>Fungi on Trees. An Arborists' Field Guide.</i> Arboricultural Association. Stonehouse. 15. Wessolly, L., Erb, M. (2016). <i>Manual of Trees Statics and Tree Inspection.</i> Berlin: Patzer-Verlag. 16. Witkoś-Gnach K. (2022). <i>Tree inspection. Manual for tree assessor – basic level</i> 	

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from Chapter 1.5.1 (Diagnostic Features on Trees) of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the right choice:

1. What does the term "diagnostic feature" mean in the context of tree assessment and management? (c)
 - a. The tree's height and width
 - b. The colour and shape of the tree's leaves
 - c. Symptoms that provide information about the tree's physiological or mechanical condition**
 - d. The type of soil in which the tree is planted
2. What is compensatory growth in the context of trees? (b)
 - a. The process of replacing a tree that has been cut down
 - b. The tree's ability to adapt by initiating additional growth**
 - c. The tendency of trees to grow towards sunlight
 - d. The spread of tree roots to reach more nutrients
3. Diagnostic features on trees can originate from which of the following factors? (c)
 - a. Biotic factors only
 - b. Abiotic factors only
 - c. Both biotic and abiotic factors**
 - d. Neither biotic nor abiotic factors
4. Which of the following is NOT considered a diagnostic feature of a tree's trunk? (d)
 - a. Bark damage
 - b. Growth abnormalities
 - c. Fungal fruiting bodies
 - d. Soil compaction**
5. Which of the following is an example of a tree's compensatory growth? (a)
 - a. Branch thickening in response to load**
 - b. Leaf colour change due to seasonal variations
 - c. Increase in tree height during the growing season
 - d. Shedding of leaves during the autumn season
6. In the context of trees, what does "dendro microhabitats" refer to? (a)
 - a. Small habitats in trees that support biodiversity**
 - b. Specific parts of a tree, such as roots, trunk, and branches
 - c. Plant diseases that affect trees
 - d. Areas of a forest densely populated by trees

Answer the open questions

1. Explain how the term "diagnostic feature" is used in tree assessment and why it's important for tree management.
2. How does a tree's compensatory growth function in response to damage or stress?
3. Describe how diagnostic features serve as dendro microhabitats and explain their ecological significance.

Exercises:

1. Imagine you are a European tree technician inspecting a mature tree in a public park. You observe that the tree has several broken branches, fungal fruiting bodies on its roots, and noticeable thickening near the base of some branches. Based on these observations, write a brief report on the tree's condition, assess the likelihood of failure, and recommend remedial actions.
2. Select three common diagnostic features observed in trees and research each of them in detail. Prepare a brief report discussing what each feature indicates about a tree's health and stability and how it impacts the tree's function.

Syllabus

related to Study Guide chapter 1.5.2

Training: Foundations of Tree Management
Subject: Tree assessment
Total Hours: 24

Short description of the training subject: This training is designed to equip participants with the skills and knowledge necessary to conduct tree assessments following the latest industry standards and best practices. It emphasises both basic and advanced tree assessment techniques. Furthermore, the training highlights the integral role of tree assessment in risk management.

Educational objective: To gain knowledge about tree assessment in line with current industry standards and best practices. It aims to equip participants with the skills and understanding necessary to effectively assess trees, identify potential risks, and propose appropriate mitigation measures. Furthermore, the training seeks to clarify the connection between tree assessment and risk management, enabling attendees to apply their learning in practical, real-world scenarios.

The key terms are: *acceptability of risk, advanced tree assessment, basic tree assessment, benefit-risk analysis, branch or tree failure, diagnostic features, diagnostic tools, leaf colour, likelihood of tree decline, mechanical integrity, pest and diseases, physiological condition, risk analysis, risk of benefit loss, risk of harm, shoot growth, structural stability, tree architecture, tree assessment process, tree biology, tree development stage, tree life expectancy, tree stability, tree work recommendations, vitality.*

Educational outcome(s):

Knowledge: Student knows:

1. the process and significance of arboricultural tree assessment;
2. various methods and levels of tree assessment;
3. how tools and instruments are used in tree assessment;
4. how to perform a comprehensive basic assessment, considering all necessary factors and parameters;
5. the possibilities and limitations of advanced assessment;
6. how to prepare assessment reports, which include recommendations.

Skills: Student is able to:

1. carry out arboricultural tree assessments effectively, understanding the significance of the process;
2. use various methods and understand different levels of tree assessment, applying them as per the requirement;
3. use appropriate tools and instruments for conducting tree assessments, thereby enhancing the accuracy and effectiveness of the process;
4. conduct comprehensive basic assessments, considering all necessary factors and parameters and drawing meaningful conclusions from these assessments;
5. understand and prescribe the advanced assessment techniques, their capabilities and limitations, and the ability to employ these techniques when necessary;
6. prepare detailed, clear, and comprehensive assessment reports, complete with recommendations for management or intervention strategies.

Teaching Methods

Lectures on tree assessment principles, detailing how various diagnostic features influence the condition and health of trees (6 hours).

Case study to present real-life scenarios (2 hours).

Field exercise to identify and perform basic tree assessment and propose management objectives (16 hours).

Key issues: principles of tree assessment, levels of tree assessment, tools in tree assessment, basic tree assessment, advanced tree assessment, diagnostic features, reports, tree life stages, tree species specification	
Required equipment and teaching aids: Exhibits with various diagnostic features Inspection forms Trees in the field (various species, age, condition) - for field exercises Probe and mallet Binoculars	
Evaluation:	Combined test (multiple choice and open questions) Exercises and simulations
Authors: Kamil Witkoś-Gnach, Julia Kończak, Instytut Drzewa	
Sources for independent learning	
<ol style="list-style-type: none"> 1. ATF (2008). <i>Ancient Tree Guide No. 4: What are ancient, veteran and other trees of special interest?</i> Ancient Tree Forum, c/o The Woodland Trust, Grantham. 2. Boddy, L. (2021). <i>Fungi and Trees. Their Complex Relationships.</i> Arboricultural Association, Stonehouse. 3. Dujesiefken, D. Jaskula, P. Kowol, T. Lichtenauer, A. (2018). <i>Baumkontrolle unter Berücksichtigung der Baumart. Bildatlas der typischen Schadsymptome und Auffälligkeiten. 2., Überarbeitete und erweiterte Auflage,</i> Haymarket Media, Braunschweig. 4. Dujesiefken D., Fay N., Jan-Willem de Groot, Nigel de Berker (2016). <i>Trees – a Lifespan Approach. Contributions to arboriculture from European practitioners:</i> http://drzewa.org.pl/en/publikacja/trees-a-lifespan-approach-contributions-arboriculture-from-european-practitioners/ 5. Dujesiefken, D. Liese, W. (2015). <i>The CODIT - Principle - Implications for Best Practices.</i> International Society of Arboriculture, Champaign, Illinois. 6. Dunster, J. A.; Smiley, E. T.; Matheny, N.; Lilly, S. Book. (2017). <i>Tree risk assessment manual 2017,</i> ISA. 7. FLL (2020). <i>Baumkontrollrichtlinien – Richtlinien für Regelkontrollen zur Überprüfung der Verkehrssicherheit von Bäumen,</i> Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e. V., Bonn. 8. Hiron A., Thomas P. (2018). <i>Applied Tree Biology.</i> Wiley, Oxford. 9. Humphreys, D., Wright, C. (2021). <i>Fungi on Trees. A Photographic Reference.</i> Arboricultural Association, Stonehouse. 10. Humphrey, J. & Bailey, S. (2012). <i>Managing deadwood in forests and woodlands. Forestry Commission Practice Guide.</i> Forestry Commission, Edinburgh. 11. Lichtenauer, A., Kowol, T., Dujesiefken, D. (2011). <i>Pilze bei der Baumkontrolle.</i> Haymarket Media, Braunschweig. 12. Lonsdale, D. (2014). <i>Principles of Trees Hazard Assessment and Management.</i> Arboricultural Association, Stonehouse. 13. Matheck C., Bethge K., Weber K. (2015). <i>The Body Language of Trees. Encyclopedia of Visual Tree Assessment.</i> Karlsruhe Institut of Technology. 14. National Tree Safety Group NTSG. (2011). <i>Common sense risk management of trees: Guidance on trees and public safety in the UK for owners, managers and advisers.</i> The Forestry Commission, Edinburgh. 15. Spatz, H.-Ch. (2013). <i>Zur Stabilität hohler Bäume.</i> W: Deutsche Akademie für Sachverständige 	

- Grün (Hrsg.): *Tagungsband Gehölzsymposium 2013 Hannover*. 224-232.
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 17. Tyszko-Chmielowiec, P., Kujawa. A. (2021). *Fungi on trees for tree inspectors*. Instytut Drzewa, Wrocław.
 18. Watson, G., Green, T. (2011). *Fungi on Trees. An Arborists' Field Guide*. Arboricultural Association. Stonehouse.
 19. Wessolly, L., Erb, M. (2016). *Manual of Trees Statics and Tree Inspection*. Berlin: Patzer-Verlag.
 20. Witkoś-Gnach K. (2022). *Tree inspection. Manual for tree assessor – basic level*
 21. http://tree-assessor.dobrekadry.pl/wp-content/uploads/2022/07/inspekcja_drzew_final_EN_lekki.pdf

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from Chapter 1.5.2 (Tree Assessment) of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the right choice:

1. The main objectives of tree assessment include: (d)
 - a. Maintaining public safety
 - b. Monitoring tree health
 - c. Assessing the structural integrity of trees
 - d. All of the above**
2. The term "diagnostic features" in the context of tree assessment refers to: (b)
 - a. The physical characteristics of a tree
 - b. Injuries, decay, damage, or other conditions that affect the functioning of a tree**
 - c. The environmental benefits provided by a tree
 - d. The height and width of a tree
3. Tree risk assessment is: (b)
 - a. The same process as tree assessment
 - b. A specific process used to identify, analyse, and evaluate tree-related risks**
 - c. A technique used only in traffic safety management
 - d. None of the above
4. Which of the following tools is NOT typically used in basic tree assessment?(d)
 - a. Mallet
 - b. Binoculars
 - c. Probe
 - d. Sonic Tomography**
5. Advanced Tree Assessment is: (b)
 - a. A basic visual examination of a tree
 - b. A follow-up stage to the initial assessment that uses more detailed and complex methods**
 - c. A quick evaluation process
 - d. None of the above
6. What is the role of the European Tree Assessment Standard (ETAS)? (c)
 - a. To provide a basic guideline for tree assessment**
 - b. To give legal backing to the process of tree assessment
 - c. To guide tree assessors in conducting thorough and standardised assessments**
 - d. To provide legal punishments for incorrect tree assessments
7. What does a tree's physiological condition refer to?(c)
 - a. The structural integrity of the tree
 - b. The tree's ability to withstand environmental conditions
 - c. The tree's ability to carry out all life processes properly**
 - d. The tree's age and species
8. Which method examines the wood structure of a trunk by comparing the flow time of a shock wave between sensors mounted on the trunk?(a)
 - a. Sonic Tomography**
 - b. Static Pulling Test
 - c. Dynamic Load Test
 - d. Resistance Drills
9. In tree risk management, the term "benefit-risk balance" refers to: (d)
 - a. Balancing the economic benefits of cutting down a tree with the risks of keeping it standing
 - b. Comparing the health benefits of trees to the risks they pose to public safety
 - c. The decision to prioritize tree benefits or risks in a given situation
 - d. Balancing environmental and conservation considerations with the need to manage public safety requirements**

Answer the open questions

1. Describe the role of tree assessment in urban planning and biodiversity conservation.
 2. How is the mechanical integrity of trees evaluated in a tree assessment?
 3. What is the difference between basic and advanced tree assessment, and when is each one used?
 4. Describe the process of basic tree assessment (tree inspection). What does it involve and what is its purpose?
-

Exercises:

1. Choose a mature tree in a nearby area and conduct a basic tree assessment. Use tools such as a mallet, metal probe, and binoculars to evaluate the tree's condition, paying attention to the trunk, roots, and canopy. Take photographs for documentation and record your findings, noting any signs of disease, decay, or structural instability.
2. In a group of three, simulate a tree assessment process where one person acts as the tree assessor, one as the tree owner, and the last person as an observer. Choose a tree, conduct an assessment, and navigate the communication process between the assessor and owner. Discuss the interaction afterwards, focusing on the effectiveness of the communication and the clarity of the final assessment report.

Syllabus related to Study Guide chapter 1.6.2

<p>Training: Foundations of Tree Management Subject: Tree revitalisation and Tree site improvement Total Hours: 6</p>	
<p>Short description of the training subject: For the practical training, an mature tree with poor vitality but with potential for having an improved water and carbohydrate balance and, therefore, a prolonged life span, should be available. Furthermore, possibilities for digging one or more holes in the soil for analysis should be ensured. The focus of the training is to achieve improved tree health through improvements of the growth media.</p>	
<p>Educational objectives:</p> <ul style="list-style-type: none"> ▪ To train the ability to diagnose the most important factors and mechanisms responsible for poor tree vitality. ▪ To diagnose the options for arboricultural improvements of the most crucial factors and mechanisms. ▪ To suggest the most suitable technical measures for improving the tree's growing conditions. ▪ To train the ability to describe and analyse a soil profile. ▪ To train the ability to identify "root friendly" and "root hostile" soil horizons and diagnose the reason(s) for the absence of roots in root-hostile horizons. ▪ To train the ability to judge the degree of soil compression in each identified soil horizon (the "screwdriver test"). 	
<p>The key terms: <i>Tree health and vitality. Tree degeneration. Poor soil conditions. Root vitality and turn-over, Improvement of growth media, revitalisation.</i></p>	
<p>Educational outcome(s):</p>	
<p>Knowledge</p>	<p>Skills</p>
<p>The student knows about:</p>	<p>The student is able to:</p>
<ol style="list-style-type: none"> 1. tree structure and function; 2. tree diagnosis and assessment; 3. the material, equipment, tools and machines required for soil decompaction, aeration, irrigation and draining. 	<ol style="list-style-type: none"> 1. evaluate vitality and the remaining life time of the tree; 2. analyse and interpret the soil's chemical, physical, and biological components; 3. measure the compaction of the soil; 4. evaluate the probability of a successful revitalisation.
<p>Teaching methods:</p>	
<p>Indoor lecture - includes applied soil science, how to describe a soil profile, what makes a soil root "friendly" and what makes a soil root "unfriendly", as well as the tree's adaptation to the soil: Present adaptations of tree roots to deep versus shallow rootable soils.</p> <p>Outdoor workshop - students describe a soil profile. Focus specifically on signs of root activity, discuss the presence/absence of roots in the soil profile. Discuss factors and mechanisms. Eventually, check the soil compression of every soil horizon by performing horizontal tests with the penetrometer probe. Consider if it is possible to solve the major constraint(s) for root growth in deep soil layers, and 'and decide which techniques are available for this task. Finally, provide an estimate of how long the tree's remaining life span can be expanded with the suggested measure.</p>	
<p>Key issues: Basically, the topic is about prolonging the remaining life span of the tree and thus prolonging important tree functions (biodiversity, aesthetics, micro climate, cooling function, etc).</p>	

Required equipment and teaching aids – specific for this teaching area

Mallet and rot probe

Penetrometer

Spade and shovels

Water (plenty) for wetting soil samples and eventually for improving soil water content before test of soil compression

Also water and towels/tissue for cleaning hands and tools

Equipment of pH-assessment and test of aggregate stability

Table to work on and plastic/sheet to kneel on

Author: Christian Nørgård Nielsen, Skovbykon

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3. Kubisch P, Hertel D, Leuschner C (2016): *Fine Root Productivity and Turnover of Ectomycorrhizal and Arbuscular Mycorrhizal Tree Species in a Temperate Broad-Leaved Mixed Forest. Forest. Front. Plant Sci. 7:1233. doi: 10.3389/fpls.2016.01233*
4. Nielsen, C.C.N. (2007): *Træers generelle ældelses- og degenerations-mekanismer. Diagnostisering og påvirkning af degenerationshastigheden. (General aging and degeneration mechanisms of trees. Diagnosing and influencing the rate of degeneration).* Source:
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[https://www.skovbykon.dk/images/stories/PDF_skovbykon/Notat_3_Traeers_Aeldelse_for skellige_miljoer_og_modvirkning.pdf](https://www.skovbykon.dk/images/stories/PDF_skovbykon/Notat_3_Traeers_Aeldelse_for_skellige_miljoer_og_modvirkning.pdf)

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from chapter 1.6.2 of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the best choice:

In the process of tree revitalisation, what is the role of improving the tree's water- and carbohydrate balance? (b)

- a. To enhance the tree's photosynthesis
- b. To stimulate the tree's regenerative and protective processes**
- c. To change the colour of the tree's leaves
- d. To make the tree grow taller

What does improving the growth media of trees mean? (b)

- a. Planting more trees
- b. Improving the soil in which the trees are growing**
- c. Fertilising the trees with chemical nutrients
- d. Watering the trees more frequently

What is the most common cause of urban trees decline? (c)

- a. Diseases
- b. Pests
- c. Poor soil conditions and soil compaction**
- d. Weather conditions

What is the aim of tree revitalisation when dealing with the tree's carbohydrate balance? (b)

- a. To speed up photosynthesis
- b. To improve the growth and defence mechanisms of the tree**
- c. To increase the tree's height
- d. To increase the tree's resistance to pests

Answer the open questions:

1. What are the essential steps to be taken in the process of tree revitalisation?
2. Explain how soil problems in urban areas can affect the health and growth of trees.

Syllabus related to Study Guide chapter 1.2.1

Training: Foundations of Tree Management
Subject: Soil Science
Total Hours: 40, including 16 hours on-site learning, and 24 hours independent study

Short description of the training subject:

The chapter *Soil science* provides an understanding of the concept of soil as an integral part of the ecosystem. It also provides knowledge about soil health and its importance, as well as the factors that affect soil health. In order to understand these concepts, the chapter includes subsections about the principles of soil formation, the physical, chemical, and biological properties of soil, and the natural processes taking place in soil.

Educational objective: Knowledge of soils is a prerequisite for learning the following chapters: ecology and biodiversity, site selection, establishing of trees, visual tree assessment and hazard analysis, tree care and remedial operations. An important part is learning how to evaluate a site's suitability for growing trees, which includes on-site practical soil examination and testing.

The key terms are: *soil, soil horizons, layers, topsoil, subsoil, parent material, weathering, soil texture, structure, porosity, density, nutrients, pH, pollutants, soil biota, organic matter, humus, mycorrhiza, physical, chemical and biological processes; nutrient and water cycle; organic carbon, humus and humification, soil food web, gas exchange, clay-humus complexes, cation exchange capacity, compaction, data collection, site observation, soil sampling, laboratory tests.*

Educational outcome(s):

Knowledge: Student knows about:	Skills: Student is able to:
<ol style="list-style-type: none"> 1. The physical, chemical, and biological characteristics of soils; 2. soil texture, structure and profile; 3. the role and importance of mycorrhizae for the tree; 4. the different aspects of soil sampling for analysing the mineral balance, organic matter content and/or soil texture; 5. the process of data collection on a tree site concerning soil; 6. how soil compaction affects the health of trees; 7. the water balance of the soil; 8. how much soil volume is required for trees of different sizes (rootable soil volume); 9. the importance of organic matter in relationship with the soil food web as a basis for soil health. 	<ol style="list-style-type: none"> 1. collect appropriate data related to a particular growing site; 2. describe the soil horizons based on certain profile hole; 3. conduct an on-site soil assessment using appropriate methods; 4. take soil samples for laboratory analysis; 5. interpret laboratory analysis results. 6. assess the sufficiency of the volume of growing medium for a specific sized tree in a particular growing site.

Teaching Methods

Lessons are divided into classroom lectures and outdoor fieldwork (16 hours total). An important part of the learning involves independent study using books, online materials, and other sources (24 hours total). The classroom lectures will be divided into introductory lectures (4 hours) and summary lectures (for review, feedback, and evaluation)(4 hours). Between the lectures will be one day of on-site fieldwork (8 hours).

<p>Key issues: In the course of the studies, an overview will be provided of soil health, soil formation, fundamental soil characteristics, natural processes of soil, and site assessment of soil.</p> <p>In the course of the field study, attention will be paid to the following: soil horizons, profile, texture, soil biota, etc. Students will practice using various tools and equipment for assessment of soil, including taking a soil sample for lab analysis, pH test, etc.</p>	
<p>Required equipment and teaching aids</p> <p>Transport for excursions, suitable clothing for outdoor work, microscope (>50X), hand augers, ground probes, geometer, penetrometer, shovels, screwdriver, tape measure, pH tester, large plastic bags or tarp, zip-lock bags.</p>	
<p>Evaluation (see ANNEX 1):</p>	<ol style="list-style-type: none"> 1. Combined test (multiple choice and open questions) 2. Applied exercises
<p>Authors: Aino Mölder and Robert Gustav Oetjen, Luua Forestry School</p>	
<p>Sources for independent learning:</p> <ol style="list-style-type: none"> 1. ETT Study Guide Chapter 1.2.1 Soil science 2. Hennig, E. (2015). Humus: What is it and how is it formed? https://www.ecofarmingdaily.com/build-soil/humus/humus-how-is-it-formed/#:~:text=The%20Clay%2DHumus%20Complex&text=In%20humus%2C%20different%20nutrients%20are,%E2%80%9Cclay%2Dhumus%20complex.%E2%80%9D 3. O'Geen, A. T. (2013) Soil Water Dynamics. Nature Education Knowledge 4(5):9 4. https://www.nature.com/scitable/knowledge/library/soil-water-dynamics-103089121/ 5. ScienceDirect. (2015) Field Capacity. 6. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/field-capacity 7. Soil Science Society of America (SSSA). (2019, July 15) What are soil aggregates? https://soilsmatter.wordpress.com/2019/07/15/what-are-soil-aggregates/ 8. Sposito, G. (2023, February 6). soil. Encyclopedia Britannica. https://www.britannica.com/science/soil 9. University of Minnesota Extension. (2018) Soil compaction. 10. https://extension.umn.edu/soil-management-and-health/soil-compaction 	

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from Chapter 1.2.1 of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

Select the best choice:

1. What proportion of the volume of the growing medium should be made up of pores containing water and/or air? (d)
 - a. ~5%
 - b. ~25%
 - c. ~45%
 - d. ~50%**
2. Which of the following soil properties is so fundamental that it affects all soil processes and regimes (e.g., water regime, thermal regime, soil biota, air regime, etc.)? (d)
 - a. texture
 - b. mycorrhizae
 - c. pH
 - d. nutrients content**
3. Mycorrhizae is (c)
 - a. a species of decay-causing fungi.
 - b. shallow roots, from which root suckers develop.
 - c. a symbiotic association between a fungus and a plant consisting of plant root and fungal cells.**
 - d. rooting stimulator to be added to the growing medium of street trees.
4. Which of the following statements describes the bulk density of soil? (a)
 - a. the mass (in kg) of 1 m³ of unaltered soil, which is most often determined by field capacity;**
 - b. the mass of organic matter (in kg) found in 1 m³ of soil.
 - c. the mass of the mineral part (in kg) found in 1 m³ of soil.
 - d. none of the above answers is correct.
5. Often, street trees grow more poorly than forest trees of the same species. What could be the reason for this? (d)
 - a. The soil of street trees may not contain fungal spores suitable for the development of mycorrhizae.
 - b. The soil of street trees may be too compacted.
 - c. Street trees may suffer from a lack of water if impermeable pavements are used.
 - d. All of the above answers are correct.**

Answer the open questions:

1. Explain the concept of soil health.
2. What is the rootable soil, and how can the minimum volume required for good tree growth be determined?

Exercises:

- 1) Assessment of the suitability of the soil for growing trees
Dig a profile hole to a depth of 1 meter. Observe and name the soil horizons. Determine the texture and pH of the topsoil using test strips or other field testers. Based on observations, evaluate the content of organic matter, including humus, as well as the presence of other materials. Based on observations and other studies, assess the suitability of the soil for growing woody plants.
- 2) Soil sampling
Take a soil sample from the profile hole wall following the sampling methodology. Complete the necessary documents, including the order for the soil laboratory, and take the sample to the laboratory. Interpret the results of the analysis and assess the suitability of the soil for growing different species of woody plants.

Syllabus related to Study Guide chapter 1.2.2

<p>Training: Foundations of Tree Management Subject: 1.2.2. Growing Site Selection Total Hours: 40, including 8h on-site learning, 32h independent study</p>	
<p>Short description of the training subject: The subject provides an overview of the steps for selection of a tree's growing site. The method includes the analysis of the site (both above- and underground) and creating an idea of the adult tree to be chosen. The final selection of the growing site combines both the characteristics of the growing site and the needs of the desired tree. In addition, the chapter introduces tree species selection criteria for most common growing sites.</p>	
<p>Educational objective: The choice of a suitable growing site for the tree ensures its good health and saves costs related to its management. So, the chapter is important for learning the principles of ecology and economics. The prerequisite for acquiring this chapter is that the subject <i>Soil Science</i> is learned previously. The chapter <i>Growing Site Selection</i>, in turn, is a prerequisite for the acquiring of chapter 1.4.2 (<i>Tree and Shrub Planting and Aftercare</i>).</p>	
<p>The key terms are: <i>concept of three-step planning, above-ground analysis, edaphic factors, overhead infrastructure, underground infrastructure, environmental factors, urban sites, rural sites, life expectancy of trees, vision of fully grown tree, aesthetic qualities, ecosystem services, biodiversity, hardiness, hardiness zones, shade tolerance, climate changes, native species, alien species, invasive species, gardens, parks, paved areas, coastal areas.</i></p>	
<p>Educational outcome(s):</p>	
<p>Knowledge: Student knows about:</p>	<p>Skills: Student is able to:</p>
<ol style="list-style-type: none"> 1. compare different site conditions for urban and countryside trees, 2. choose a tree according to prevalent edaphic factors on site, 3. implement soil composition improvement methods where necessary, 4. select trees for specific site conditions, 5. identify aesthetic, dendrological and arboricultural features of trees and assess their suitability for specific sites and positions based on these criteria, 6. understand the influence of the site conditions to the life expectancy of trees. 	<ol style="list-style-type: none"> 1. choose a tree according to prevalent site conditions, 2. recommends appropriate soil improvement measures based on the needs of the tree 3. explain the influence of the site conditions to the life expectancy of trees.
<p>Teaching methods:</p>	
<p>Lessons are divided into on-site (8h) and independent study (32h) using books, online materials and other sources. The on-site lectures will be divided into introductory lectures (2 h), case study (4h) and summary lessons (for review, feedback and evaluation)(2h).</p>	
<p>Key issues: Above-ground site analysis. Underground site analysis. Vision of fully grown tree. Tree species selection. Primary principles for sustainable species selection: habitat and ecology, biodiversity, future (urban) climate, invasive exotic species. Secondary principles for sustainable species selection: aesthetic qualities, arboricultural qualities, selection of tree species for the most common growing sites</p>	
<p>Required equipment and teaching aids: Park or green area with different tree species. Binoculars. Soil field sampling set (gauge, penetrometer, spade)</p>	

Evaluation (see ANNEX 1):	<ul style="list-style-type: none"> • Open questions • Simulation
Authors: <i>Aino Mölder and Robert Gustav Oetjen, Luua Forestry School</i>	
<p>Sources for independent learning:</p> <ol style="list-style-type: none"> 1. ETT Study Guide Chapter 1.2.2 Growing Site Selection 2. Edward F. Gilman, Laura Sadowski. <i>Choosing suitable trees for urban and suburban sites: site evaluation and species selection</i>. University of Florida, 2007. https://hort.ifas.ufl.edu/woody/documents/EP310.pdf 3. Andrew Hiron, Henrik Sjöman. <i>Tree Species Selection for Green Infrastructure. A Guide for Specifiers</i>. Trees and Design Action Group Trust, 2019. https://www.myerscough.ac.uk/media/4932/hiron-and-sjoman-2019-tree-species-selection-for-green-infrastructure-v13.pdf 4. Environment Resources Authority. <i>List of Invasive Alien Species of Union Concern, 2015. Regulation (EU) No 1143/2014</i>. https://era.org.mt/topic/list-of-invasive-alien-species-of-union-concern/ 5. <i>Hardiness zones in Europa</i>. https://www.gardenia.net/guide/european-hardiness-zones#:~:text=The%20above%20European%20Hardiness%20Zone,round%20conditions%20in%20y our%20area 	

Sample exercises for evaluation

The following sample questions for testing students' understanding are based on material from the sources from chapter 1.2.2 (Growing Site Selection) of the ETT Study Guide. Teachers are encouraged to find and make up other practical test questions.

1. Answer the open questions

- 1) Explain why it is important to plant the right tree in the right place.
- 2) Explain how you decide if there is enough room for the root system of the tree to be planted.
- 3) Explain how you understand 3-step planning when choosing a tree location.
- 4) How do the growing conditions of trees differ in the urban and in the natural environment?
- 5) What does species diversity mean to you? How and to whom does biodiversity benefit?

2. Simulation:

In the coming year, it is planned to reconstruct the street in the part of the city with private houses. The street is not very wide: it consists of a 6-meter-wide driveroad and a 1.5-meter-wide sidewalk. There is a 1.5 meter wide strip of grass between the driveway and the sidewalk where the residents would like to plant trees. To prevent trees from being planted too close to the driveway, it is planned to narrow it by 1 meter, and make it one-way. At the expense of the 1-meter-wide strip that will remain free from traffic, it is planned to expand the area intended for planting trees. Thus, the width of the driveway would remain 5 meters and the width of the area with trees would remain 2.5 meters. Since the sidewalk, including paving, has only recently been built, it would not be affected by the reconstruction and its width would remain the same. A question for you as an expert:

- 1) Make a plan of activities related to planting, incl. time table.
- 2) What tree species do you recommend the residents to choose for planting

Examples of training simulations tasks used in the Project workshop

Preparation of a contract and plan of approach for the city of Bosbergen.	36
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Benchmark Assignment: Certification European Tree Technician

Management Exercises in Economy, Law and Social Studies (Practical Part)

Preparation of a contract and plan of approach for the city of Bosbergen.

Qualification:	European Tree Technician: Quotation/offer, plan of approach/work description
Duration:	Approximately 5 minutes: reading assignment. Approximately 5 minutes of gathering oral information for the council representative. Approximately 170 minutes: working on the assignment, creating plan of approach and offer. About 15 minutes: oral interview with client.
Tools:	PC with Word and Excel; pen and paper. A calculator may be used.
Maximum number of points to be earned:	100 points
The number of points required to complete the test sufficiently:	At least 50% of the maximum number of points to be achieved.
Additional information:	All exam papers including drafts and notes must be handed in before leaving the exam room.

Description of the Situation:

The municipality of Bosbergen manages approximately 15,000 street/avenue and park trees. In the last ten years, the municipality has paid little attention to pruning and tree management. Tree safety checks have not been carried out for ten years. There is a huge management backlog. The municipality receives many complaints from residents about fallen branches. Claims for damages also come in regularly. The municipality, therefore, has decided to start the tree management in an organised manner.

Due to the backlog, it is expected that a lot of trees will have to be removed and new ones planted.

The municipality asks you to prepare a quotation/offer for the preparation of a tree contract. **It concerns your consultancy activities.** The contract will be drawn up by the project office of the municipality under the responsibility of the council.

Precondition:

The municipality has the following requirements:.

- The contract to be drawn up for the work has a duration of at least three calendar years.
- An inventory of the tree stock must be made as a basis for the contract.
- The municipal trees must be 'safe' and in a good state of maintenance within three years.
- The municipality wants a maximum of six contractors to make an offer. They want to carry out a selection among interested contractors. Your plan must state how it can best achieve this.
- On the basis of which criteria can the municipality best select contractors?
- The following items must be included in your quotation/offer: Advising or supervising the writing of specifications for the contract and supervising the work by the contractor during the contract period.

Assignment

You are invited by the municipality of Bosbergen, as an advisor, to prepare the project, so that specifications can be made for the contract by the project office of the municipality. You are also expected to supervise the correct execution of the contract by the contractor for a duration of 3 years.

1. **Prepare a plan of approach of a maximum of 4 A4 sheets and a specified quotation/offer of a maximum of 2 A4 sheets for your advisory work for the municipality.**

This should cover the following:

- Advising/supervising/performing the work done by you, so that the municipal project office can draw up specifications for the contract based on the data/information delivered by you.
- Supervising the work of the contractor in accordance with the specifications of the contract.

Indicate how much you charge for the different parts of your supervision tasks.

2. **Additional questions. What do you advise regarding the following**

- Contractor selection criteria

The client's selection criteria for your offer are:

The tree-technical and policy aspects must be anchored in your PVA and your offer. This is to give the client the confidence that customisation will be provided. The information provided must be concrete, correct, and realistic.



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Benchmark Assignment: Certification European Tree Technician

Management Exercises in Economy, Law and Social Studies (Practical Part)

Advice on new tree planting for the municipality of Enschede.

Qualification:	European Tree Technician.; Quotation/offer - work/management plan
Duration:	Approximately 5 minutes: reading assignment. Approximately 5 minutes of gathering oral information. Approximately 160 minutes: working on the assignment. Approximately 15 minutes: Oral presentation
Tools:	PC with MS Word and MS Excel; pen and paper A calculator may be used.
Maximum number of points to be obtained:	100 points
The number of points required to complete the test sufficiently:	Workplan: 50 points. Quote/offer: 20 points. Cost estimate for the planting project: 20 points. Presentation: 10 points At least 50% of the maximum number of points to be achieved
Additional information	

Description of the Situation:

The city of Enschede wants to become a lot greener in the coming years. Part of that ambition is to plant 170,000 trees, one for every resident of the city. The plan is part of the Rural Area strategy. In addition, the city wants to improve the quality of life through the planting of trees, make the agricultural sector more sustainable, and strengthen the local estates around Enschede. The city also wants to grow to a population of 170,000 in the long term. Enschede's plan is in line with national and regional plans. A few months ago, the political parties Greenfront and the Socialist Party in the city council of Enschede came up with the idea not only to plant new trees in rural areas but also to strive for a maximum occupancy of the public space with trees within the city limits. The aim is to achieve an improvement in the quality of the habitability, rainwater infiltration, and climate adaptation in the city. This wish has been adopted by the municipality and included as an ambition in the 2022 tree management plan. The idea is to make use of vacant plots and other unplanted areas, such as roadsides. The council has commissioned the project office of the municipality to conduct an exploratory study into the possibilities of planting 600 new trees in the city. Based on a preliminary study of digital maps, the project office has selected some 300 potential places for the new plantings. The project office has approached you to map out which locations are suitable for achieving the goals.

Preconditions:

- The newly planted trees must be able to grow normally for at least 40 years in terms of underground and above-ground growing space.
- Where possible, the new trees must fit in with the existing green structures.
- The tree must be able to anticipate changing climatic conditions.
- The new trees within this project may not replace existing trees.
- The project is limited to the municipal land within the city boundaries.
- Stakeholders must be taken into account in order to have wide support for the project.
- Communication internally (municipality) and externally (other stakeholders) must be conducted during the process of project.

Assignment:

You are invited by the project office of the municipality of Enschede to write a recommendation / giving advice for the realisation of the new tree plantings in the city. The project office lacks expertise in the field of trees. That is why you are asked to advise. Based on your advice and report, the municipality will be able to take a decision about a budget and whether the intended plans can go ahead.

1. Make a specified quotation of a maximum of 2 A4 single pages for the project office of the municipality for your consultancy work.

2. Write a work plan of a maximum of 4 A4 single pages including your consultancy work, reporting, communication process, cost estimate, management, and tendering process for the project office of the municipality.

Take into account the following elements:

- a. An inventory of pre-selected growing sites.
- b. Preconditions for the selection of growing sites.
- c. Assortment selection.
- d. Advice on the participation of residents and other stakeholders.

3. Draw up a cost estimate for the planting of the new trees and describe how you will market this project.

- a. Cost estimate
- b. Management and supervision
- c. Tender prices



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Benchmark Assignment: Certification European Tree Technician

Management Exercises in Economy, Law and Social Studies (Practical Part)

Revitalization museum castle park Ruurlo

Qualification:	European Tree Technician : Plan of approach, quotation/offer						
Duration:	Approximately 10 minutes: reading the assignment. Approximately 10 minutes: oral information gathering. Approximately 160 minutes: elaboration of the assignment. Approximately 15 minutes (second day): oral explanation						
Tools:	A PC with Word and Excel (provided); a pen and paper (provided). A calculator may be used.						
Maximum number of points to be achieved:	100 points						
The number of points required to complete the test sufficiently:	At least 50% of the maximum number of points to be achieved. <table border="0"> <tr> <td>1. Plan of approach</td> <td>60 points</td> </tr> <tr> <td>2. Quotation of consultancy work</td> <td>30 points</td> </tr> <tr> <td>3. Oral explanation of the results</td> <td>10 points</td> </tr> </table>	1. Plan of approach	60 points	2. Quotation of consultancy work	30 points	3. Oral explanation of the results	10 points
1. Plan of approach	60 points						
2. Quotation of consultancy work	30 points						
3. Oral explanation of the results	10 points						

Description of the Situation:

In Ruurlo, a new museum MORE will be opened. It is located in the castle Huize Ruurlo. The castle and gardens have been completely renovated and the park around it is the last to be reconstructed. **As a tree consultant, you will be asked to support the client in preparing a tender for the pruning and safeguarding of the trees around the castle and the avenues around it.** The site is approximately 5 ha with about 400 trees in avenues/lanes and groups, and about 60 solitary monumental trees. The trees have been severely neglected due to a lack of maintenance over the past 35 years. There is a lot of large dead wood present and at least 15 of the solitary-growing trees are in the declining stage of their life span.

You are asked to provide an offer for this job, in which you will include a plan of approach. You will receive the assignment after approval of the quotation and the plan of approach.

Precondition:

- Due to the planned opening of the museum, the pruning and all other tree work must be carried out before 1st October 2023. This is the opening date of the museum.
- The park is open to the public during the work.
- The avenues may not be closed during the work. Work traffic connected with the renovation of the museum must be able to continue.
- The newly renovated paths and existing art objects on the estate must not be damaged.
- The contractor must take appropriate traffic measures on the access road and the parking spaces.

Problems to be solved:

- The park must be safe for the expected large numbers of visitors of the museum.
- There is a problem caused by the trees that are too close to the buildings. Due to the shadow they cast, there is a lack of natural light inside the castle for the art works. This should be resolved.
- In the tree near the tea garden, there are birds nesting every year. This is a nuisance and has to stop.

Other requirements:

The management of the museum wants several contractors to be asked for a price to carry out the tree work.

Assignment

You are invited by the management of the museum to advise on the project. You are expected to prepare the project, assist the management in selecting the contractor, and supervise the project in the execution phase.

Before you receive the assignment, the management wants a plan in which you have to specify what you want to do and how much it will cost. Also, you must include a description of the tasks that will have to be done by the management. Give a clear description of your activities as well as the intermediate and final results.

1. Prepare a plan of approach for the management (a maximum of 4 pages (A4)). The plan should include:
 - your consultancy activities for the project;
 - the tender procedure; and
 - supervision of the execution of the work of the contractor.
2. Prepare a detailed quotation of your consultancy work for the management (a maximum of 2 pages (A4)).



PROMOTION AND ALIGNMENT OF EUROPEAN TREE TECHNICIANS (ETT) QUALIFICATION IN EUROPE
ETT 2020 ERASMUS+ PROJECT WORKING GROUP

	<p>European Arboricultural Council e.V. Address: Haus der Landschaft, Alexander-von-Humboldt-Straße 4, 53604 Bad Honnef, GERMANY</p>	<p>www.eac-arboriculture.com</p>
	<p>Bulduru Tehnikums SIA Address: Viestura 6, Jurmala LV2010, LATVIA</p>	<p>www.bulduri.lv</p>
	<p>Instytut Drzewa Sp. z o.o. Address: ul. Obozna 145, 52-244 Wrocław, POLAND</p>	<p>www.instytut-drzewa.pl</p>
	<p>Luua Metsanduskool Address: Luua, 49203 Jõgeva County, ESTONIA</p>	<p>www.luua.ee</p>
	<p>Praktijk Centrum Bomen Address: Asselsestraat 328 b, 7312 TR, Apeldoorn, NETHERLANDS</p>	<p>www.pcbomen.nl</p>
	<p>SkovByKon Address: Nørremarksvej 5, DK-6064 Jordrup, DENMARK</p>	<p>www.skovbykon.dk</p>
	<p>Sveriges arboristförbund SAF Adress: c/o Trädmästarna, Drottningholmsvägen 80, Stockholm112 43, SWEDEN</p>	<p>www.sverigesarboristforbund.se</p>
	<p>VIVES Hogeschool Address: Wilgenstraat 32, 8800 Roeselare, BELGIUM</p>	<p>www.vives.be</p>





Haus der Landschaft, Alexander-von-Humboldt-Straße 4,
53604 Bad Honnef, Germany
www.eac-arboriculture.com



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