



Australian Government

AHCARB810 Analyse edaphic interactions of trees and structures

Release: 1

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Modification History

Release	Comments
Release 1	This version released with AHC Agriculture, Horticulture and Conservation and Land Management Training Package Version 5.0.

Application

This unit of competency describes the skills and knowledge required to analyse the edaphic interactions of trees and structures through investigations into soil characteristics and effect on tree and structure stability, tree roots and interactions with structures, and their relationship resulting in potential tree and structural failure.

The unit applies to individuals with highly specialised advanced theoretical and technical knowledge for professional work and research in arboriculture. They exercise advanced cognitive, technical and communication skills and demonstrate complete autonomy, judgement and adaptability in research and analysis for complex problems.

No licensing, legislative or certification requirements are to this unit at the time of publication.

Pre-requisite Unit

The prerequisite unit of competency for this unit is:

- AHCARB804 Analyse tree structure and biomechanics.

Unit Sector

Arboriculture (ARB)

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Determine soil attributes for a specified site	1.1 Investigate angle of repose of soils and impact on structures 1.2 Investigate soil plasticity and impact on structures 1.3 Investigate the effects of soil moisture on cohesion and plasticity 1.4 Investigate modes of soil liquefaction and soil stability 1.5 Conduct tests on soil properties to establish soil stability for

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	specified site 1.6 Assess level of soil cohesion for site 1.7 Determine shear strength of soil for site 1.8 Investigate load bearing capacity of soil for site 1.9 Determine mass of the soil plate for site
2. Determine root attributes for trees on site	2.1 Determine tree root morphology, division and distribution 2.2 Determine amount of buttressing 2.3 Determine anatomical features of tree roots for identification purposes 2.4 Identify tree roots based on anatomical features
3. Calculate forces from roots	3.1 Research, test and determine forces and pressures exerted by trees through roots in soil 3.2 Estimate and measure dimensions of roots exerting a force on structures on site 3.3 Calculate total surface area of the roots exerting a force on structures on site 3.4 Calculate force exerted by roots per unit of surface area of structure 3.5 Calculate total force exerted by roots of a given surface area
4. Determine attributes of structures	4.1 Measure and determine volume of structures impacted by roots 4.2 Research and calculate mass of structures on site 4.3 Determine the impact of gravity on structural mass 4.4 Determine effect of leverage of forces exerted by tree roots on structures
5. Define the root–soil matrix factors for root/soil breakage	5.1 Determine factors of root–soil matrix interactions 5.2 Investigate area of contact between root and soil 5.3 Investigate elasticity, tensile strength and breaking stress of roots 5.4 Investigate root cross-sectional morphology 5.5 Assess root plate for factors that may contribute to failure 5.6 Estimate impact of static and dynamic testing for root plate stability

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	5.7 Evaluate the likelihood of root failure by root breakage 5.8 Evaluate the likelihood of anchorage failure by soil breakage or slippage
6. Research structural engineering solutions	6.1 Investigate and assess effects of increasing mass of structure to prevent damage 6.2 Investigate and assess methods and effects of increasing the modulus of rupture to prevent damage 6.3 Investigate and assess effects of use of curved structures to prevent damage 6.4 Investigate and assess effects of soil mass and friction on structure stability 6.5 Investigate and assess effects of anchors, braces and props on trees to improve stability 6.6 Compile investigations and assessments into a reference portfolio
7. Prepare stability and expert witness reports	7.1 Prepare report on potential tree damage to structure 7.2 Provide design suggestions to mitigate potential damage 7.3 Review root plate evaluation and prepare report on stability of tree 7.4 Provide design suggestions to mitigate likelihood of tree failure 7.5 Prepare final report on potential structure and tree stability
8. Communicate with project personnel	8.1 Discuss installation and protection measures with project personnel using industry-specific language 8.2 Negotiate and resolve installation and protection issues

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Determine soil attributes for a specified site	1.1 Investigate angle of repose of soils and impact on structures 1.2 Investigate soil plasticity and impact on structures

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	1.3 Investigate the effects of soil moisture on cohesion and plasticity 1.4 Investigate modes of soil liquefaction and soil stability 1.5 Conduct tests on soil properties to establish soil stability for specified site 1.6 Assess level of soil cohesion for site 1.7 Determine shear strength of soil for site 1.8 Investigate load bearing capacity of soil for site 1.9 Determine mass of the soil plate for site
2. Determine root attributes for trees on site	2.1 Determine tree root morphology, division and distribution 2.2 Determine amount of buttressing 2.3 Determine anatomical features of tree roots for identification purposes 2.4 Identify tree roots based on anatomical features
3. Calculate forces from roots	3.1 Research, test and determine forces and pressures exerted by trees through roots in soil 3.2 Estimate and measure dimensions of roots exerting a force on structures on site 3.3 Calculate total surface area of the roots exerting a force on structures on site 3.4 Calculate force exerted by roots per unit of surface area of structure 3.5 Calculate total force exerted by roots of a given surface area
4. Determine attributes of structures	4.1 Measure and determine volume of structures impacted by roots 4.2 Research and calculate mass of structures on site 4.3 Determine the impact of gravity on structural mass 4.4 Determine effect of leverage of forces exerted by tree roots on structures
5. Define the root–soil matrix factors for root/soil breakage	5.1 Determine factors of root–soil matrix interactions 5.2 Investigate area of contact between root and soil 5.3 Investigate elasticity, tensile strength and breaking stress of roots 5.4 Investigate root cross-sectional morphology

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	5.5 Assess root plate for factors that may contribute to failure 5.6 Estimate impact of static and dynamic testing for root plate stability 5.7 Evaluate the likelihood of root failure by root breakage 5.8 Evaluate the likelihood of anchorage failure by soil breakage or slippage
6. Research structural engineering solutions	6.1 Investigate and assess effects of increasing mass of structure to prevent damage 6.2 Investigate and assess methods and effects of increasing the modulus of rupture to prevent damage 6.3 Investigate and assess effects of use of curved structures to prevent damage 6.4 Investigate and assess effects of soil mass and friction on structure stability 6.5 Investigate and assess effects of anchors, braces and props on trees to improve stability 6.6 Compile investigations and assessments into a reference portfolio
7. Prepare stability and expert witness reports	7.1 Prepare report on potential tree damage to structure 7.2 Provide design suggestions to mitigate potential damage 7.3 Review root plate evaluation and prepare report on stability of tree 7.4 Provide design suggestions to mitigate likelihood of tree failure 7.5 Prepare final report on potential structure and tree stability
8. Communicate with project personnel	8.1 Discuss installation and protection measures with project personnel using industry-specific language 8.2 Negotiate and resolve installation and protection issues

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential for performance in this unit of competency but are not explicit in the performance criteria.

Skill	Description
Reading	Identify and interpret relevant information from complex texts, reports, maps and plans to formulate a detailed understanding of soil characteristics and impact on trees
Writing	Create complex arborist reports, demonstrating control over a range of writing styles and using industry-specific language appropriate for target audience
Numeracy	Interpret complex numerical data and use complex formulae to measure and calculate volumes and mass of soils and structures for impact on tree roots

Unit Mapping Information

Code and title current version	Code and title previous version	Comments	Equivalence status
AHCARB810 Analyse edaphic interactions of trees and structures	AHCARB803 Analyse edaphic interactions of trees and structures	Performance criteria clarified Foundation skills added Assessment requirements updated	Equivalent

Links

Companion Volumes, including Implementation Guides, are available at VETNet: -
<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=c6399549-9c62-4a5e-bf1a-524b2322cf72>

Assessment Requirements for AHCARB810 Analyse edaphic interactions of trees and structures

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Performance Evidence

An individual demonstrating competency must satisfy all of the elements and performance criteria in this unit.

There must be evidence that the individual has analysed the edaphic interactions of trees and structures for a specific site and has prepared a minimum of two reports, which must include:

- a report on damage to structures by tree roots
- a report on the stability of tree with a defective or damaged root plate.

There must also be evidence that the individual has:

- investigated soil conditions that contribute to structure and tree stability, including:
 - angle of repose of soil materials
 - soil plasticity
 - impact of soil moisture on soil cohesion and plasticity
 - modes of soil liquefaction
- investigated and tested soils for properties affecting soil conditions, including:
 - measured soil moisture content and field capacity
 - determined soil texture
 - assessed level of soil cohesion
 - determined shear strength of the soil
 - investigated load bearing capacity of soil
 - calculated mass of the soil plate
- determined root morphology, division and distribution and amount of buttressing of tree
- determined species characteristics for development of tap root system
- determined anatomical features of tree roots and identified tree roots for a given tree
- conducted research tests to determine forces and pressures exerted by trees through the soil
- estimated and measured dimensions of roots exerting a force on a structure
- calculated total surface area of the roots exerting a force on a structure
- calculated force exerted by roots per unit of surface area of structure

- calculated total force exerted by roots of a given surface area
- measured and determined volume of structure
- researched and calculated mass of structures
- determined impact of gravity on mass
- determined effect of leverage on the forces exerted by tree roots on structure
- determined factors of root–soil matrix interactions
- investigate area of contact between root and soil
- investigated elasticity, tensile strength and breaking stress of roots
- investigated root cross-sectional morphology
- assessed root plate for damage, deficiencies or defects that may contribute to tree failure
- estimated impact of static and dynamic testing for root plate stability
- evaluated possible root failure by root breakage
- evaluated possible anchorage failure by soil breakage or slippage
- investigated and assessed:
 - effects of increasing mass
 - methods for, and effects of, increasing the modulus of rupture
 - effects of use of curved structures
 - effects of soil mass and friction
 - effects of use of anchors, braces and props
- compiled investigations and assessments into reference portfolio
- created a report of potential tree damage to structure and provided design suggestions to mitigate damage
- reviewed root plate assessment, prepared final report on stability of tree and provided design advice to mitigate potential tree failure
- created an expert witness report on potential structure or tree stability
- discussed installation and protection measures with project personnel
- negotiated and resolved anomalies in installation and protection measures.

Knowledge Evidence

An individual must be able to demonstrate the knowledge required to perform the tasks outlined in the elements and performance criteria of this unit. This includes knowledge of:

- impact of soil on the stability and structural integrity of structures and trees, including:
 - angle of repose of soil
 - soil plasticity
 - soil moisture content
 - field capacity of soil
 - effects of soil moisture on soil cohesion and plasticity
 - modes of soil liquefaction
- testing soils for performance characteristics and soil stability, including:
 - soil texture
 - soil cohesion

- soil moisture and field capacity
- shear strength of soils
- load bearing capacity
- calculating mass of soil plate
- tree root structures and their impact on soils and stability, including:
 - root morphology
 - root division
 - root distribution
 - buttressing
 - species development of tap root systems
 - identification of tree roots based on anatomical features
- pressures exerted by tree roots, including:
 - experimental modelling of tree root damage
 - testing tree roots impact on structures and soils
 - direct and indirect forces and pressures exerted in soils by trees
 - techniques and methods of estimating and measuring dimensions of roots
 - factors of root–soil matrix interactions
 - area of contact between root and soil
 - elasticity of roots
 - tensile strength of roots
 - breaking stress of roots
 - root cross-sectional morphology
- calculations for determining forces exerted by tree roots, including:
 - total surface area of the roots exerting forces on structures
 - forces exerted by roots per unit of surface area of structure
 - total force exerted by roots of a given surface area
 - measurement of volume of structures
 - calculating the mass of structures and the impact of gravity on mass
 - effect of leverage on the forces exerted by tree roots onto structure
- tree root health and condition and impact on tree stability, including:
 - size of root plate and extent of root plate damage
 - extent of root plate deficiencies
 - extent of root plate defects
 - impact of static and dynamic testing for root plate stability
 - likelihood of root failure by root breakage and failure of root plate
 - likelihood of anchorage failure by soil breakage or slippage
- considerations of structural design and development, and tree support to mitigate potential tree or structure damage, including:
 - effects of increasing mass of structure
 - effects of structure design and curvature of shape on strength of structures

- effects of soil mass and friction
- effects of increasing the modulus of rupture
- effects of use of tree support mechanisms
- Australian standards relevant to trees on development sites
- structure designs for mitigation of tree damage and failure
- tree protection measures
- creating reference portfolios of research and investigations, including annotations and calculations
- documenting and reporting procedures, report preparation and communicating results of analysis, including:
 - test results and assumptions
 - expert witness reports, their purpose and design
 - using the correct language in reports and reporting
- fundamentals of the concepts, basic science and technology of structural engineering, construction and architecture as relates to arboriculture and impact of trees on structures.

Assessment Conditions

Assessment of the skills in this unit of competency must take place under the following conditions:

- physical conditions:
 - a construction or development site with trees and structures or an environment that accurately represents workplace conditions
- resources, equipment and materials:
 - computer with word processing software
 - digital imaging device
 - diagnostic tools, including sounding hammer, trowel, probe, cordless drill
 - soil testing equipment
 - digital dissection microscope 10x – 100x
 - compound microscope
 - microtome, staining and slide mounting equipment
- specifications:
 - standard procedures and quality standards for performing soil analysis, tests and analysis on roots and structures
 - reference materials, reports and literature relevant to investigations and research into engineering, construction and architectural interactions with trees.

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards. In particular, assessors must have:

- arboriculture vocational competencies at least to the level being assessed

- current arboriculture industry skills directly relevant to the unit of competency being assessed.

Links

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