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Lesnická a dřevařská fakulta Mendelova univerzita v Brně

NATURE AND LANDSCAPE MANAGEMENT STANDARDS

ARBORIST STANDARDS	**PLANTING OF TREES**	**SPPK A02 001:2013**
SERIES A		

Planting of trees

Anpflanzung der Bäumen

This standard is designed to define materials and equipment and work procedures required for planting of trees in non-forest environments, including basic planning and designing principles.

References:

FLL Empfehlungen für Baumpflanzungen Teil 1: Planung, Pflanzarbeiten, Pflege, 2005
FLL Empfehlungen für Baumpflanzungen Teil 2: Standortvorbereitungen für Neupflanzungen; Pflanzgruben und Wurzelraumerweiterung, Bauweisen und Substrate, 2010

ČSN EN 12899–1 – Fixed, vertical road traffic signs, 2008
ČSN 46 4902 Cultivates of ornamental wood species. Common and basic regulations, 1984
ČSN 73 6101 Design of highways and motorways, 2004
ČSN 75 7143 Water quality. Water quality for irrigation, 1991
ČSN 83 9001 Vegetation technology in landscaping – Terminology – Fundamental special terms and definitions, 1999
ČSN 83 9011 Vegetation technology in landscaping – Vegetation technology in landscaping – Soil working, 2006
ČSN 83 9021 Vegetation technology in landscaping – Plants and plant care, 2006
ČSN 83 9051 Vegetation technology in landscaping –Vegetation during development and maintenance in green areas, 2006

Act no. 13/1997 Coll., on Roads
Act no. 20/1987 Coll. on State Heritage Management
Act no. 89/2012 Coll., the Civil Code
Act no. 114/1992 Coll. on Nature and Landscape Protection
Act no. 127/2005 Coll. on Electronic Communications
Act no. 149/2003 Coll. on putting into circulation of reproduction material of forest tree species of species important for forestry and artificial crosses, intended for forest renewal and afforestation, and amending some related laws
Act no. 254/2001 Coll. on Waters
Act no. 258/2000 Coll. on Public Health Protection and on amendment of certain acts
Act no. 326/2004 Coll. on Medical Plant Care and on amendment of certain acts
Act no. 458/2000 Coll. on Requirements for Business and Public Administration in Energy Industries

Decree no. 395/1992 Coll. on Nature and Landscape Protection
Decree no. 189/2013 Coll. on Protection of woody plants and permission of their cutting
Decree no. 83/1996 Coll. on Development of territorial forest development plans and definition of management units
Decree no. 104/1997 Coll., executing the Road Act
Decree no. 215/2008 Coll. on organisms harmful to plants and plant products and against their spread
Decree no. 32/2012 Coll. on preparations and other products for plant protection
Decree no. 327/1998 Coll., laying down the characteristics for soil ecology assessment units and the procedure for keeping records on them and updating them

Gov. Reg. no. 591/2006 Coll., on detailed minimum requirements on occupational health and safety in workplaces

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Second reader institution:
Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra
Faculty of Horticulture, Mendel University in Brno

Authorial collective:
Ing. Jaroslav Kolařík, Ph.D. (coordinator), Ing. Stanislav Flek, David Hora, DiS., Petr Imramovský, Ladislav Kejha, prof. Ing. Oldřich Mauer, DrSc., Ing. Jaromír Opravil, doc. Ing. Luboš Úradníček, CSc.

Illustrations:
Bc. David Ladra

Documentation for standard development is available in the library of NLPA CR.
Standard approved by

RNDr. František Pelc
Director of NLPA CR

Contents

1. Standard purpose and contents

The standard “Planting of trees” defines the purpose and contents of work operations implemented when planting trees growing in non-forest environments. The standard is designated for application when planting trees performing non-production functions the main purpose of which is not production of fruit, wood or other commodities. The standard deals with planting of trees starting from the maiden whip size.

It does not deal with forestry tree planting methods, planting of shrubs and woody climbing plants (see SPPK A02 003). It also sets a framework for associated planning phases (project planning) as one of the prerequisites for successful implementation of tree planting.

Legal framework

Act no. 254/2001 Coll. on Waters and on amendment of certain acts (Section 14, Para. 1 and 2) – with specified exceptions, binds planting of trees and shrubs in flood-prone areas in an extent affecting the drainage conditions to a permit from a water management authority.

Act no. 114/1992 Coll. on Nature and Landscape Protection (Section 5, Para. 4 and 5; Section 16, Para. 1, item (h); Section 26, Para 1, item (d); Section 29, item (e); and Section 34, Para. 1, item (d)) regulates deliberate dissemination of introduced plant species and crossbreeds in the landscape, and deliberate dissemination of introduced plant species in specially protected natural areas (national parks, protected landscape areas, national nature reserves, nature reserves, national nature monuments, nature monuments).

Act no. 13/1997 Coll. on Roads (Section 33) defines conditions for planting of trees and shrubs along roads in terms of viewing conditions, and road vegetation on auxiliary land along roads and other suitable land comprising parts of motorways, highways or local roads in terms of road use safety and road maintenance or management of adjacent land (Section 15).

Act no. 20/1987 Coll. on State Heritage Management (Sections 14 and 17) defines, among other things, conditions for planting and maintenance of woody plants in protected heritage buildings and zone that are cultural monuments, national cultural monuments or heritage reserves, heritage zones or within the protective zones of immovable cultural monuments, immovable national cultural monuments, heritage reserves, or heritage zones.

Act no. 326/2004 Coll. on Medical Plant Care and on amendment of certain acts, and its executive Decree no. 32/2012 Coll. on Preparations and other products for protection of plants, define the use of preparations and other products for protection of plants.

Act no. 458/2000 Coll. Requirements for Business and Public Administration in Energy Industries and on amendment of certain acts (Energy Act) defines the rights of electricity transmission and distribution system operators, gas producers and gas transport and distribution system and tank operators, and holders of licences for heat distribution to regulate vegetation endangering the operation of said systems, including on other owners' land if said owners have not done so themselves upon an invitation (Sections 24, 25, 57-60, 76). In addition, the Act deals with maintenance and planting of woody plants in protective zones of certain power system facilities, gasworks facilities and heat production or distribution facilities (Sections 46, 68 and 87); see Annex 10.

Act no. 127/2005 Coll. on Electronic Communications and on amendment of certain acts (Section 102) defines protective zones for telecommunications equipment in which permanent vegetation must not be planted without the telecommunications line owner's consent; see Annex 10.

Act no. 89/2012 Coll., the Civil Code (Section 1017) defines planting of trees (and consequences of such planting) in the immediate vicinity of shared boundaries of land plots.

2 Planning (project planning)

2.1 General site characteristics

2.1.1 A **site for planting** can be characterised, for example, by the system for classification of agricultural land development into the valued soil ecological units (BPEJ; see Decree no. 327/1998 Coll.) or using forest type complexes (SLT; see Decree no. 83/1996 Coll.). Other classification systems can be used as well, such as geobiocene type groups, reconstructed and potential vegetation or agricultural production areas and sub-areas.

2.1.2 High **water table** in an area affects both the selection of taxa and planting technique. Places with too high water table require application of special work procedures (see 4.4.8 below and Annex 14, Figures 8-9).

3.1.2 In **specific cases** (planting on slopes, in limited rootable area, etc.), supply of water to the plants has to be designed (see 4.9.8 below).

4.1.2 **Sites with a well-preserved soil profile.** These are sites with standard soil types, mostly found in open country, parks and gardens. They only require a standard level of preparation before planting (see 4.3 below).

2.1.5 **Altered sites.** Conditions for tree growth are frequently impaired in urbanised environments, particularly when planting in paved areas. The soil tends to have an altered structure, high pH, and compaction. Impermeable surfaces prevent or restrict air exchange and water absorption. Sites are frequently contaminated (e.g., salinity, leaks of petroleum products, heavy metals, etc.). Anthropogenic soils are typically characterised by an imbalanced nutrient stock, lack of humus and low biological activity.

2.1.6 In cases of significantly contaminated sites, the soil in the rootable area has to be replaced, or a taxon tolerant to the contamination type has to be used.

2.1.7 **Soil reaction.** The taxon selection has to respect soil reaction and site pedological conditions. Adjustment to the site pH is costly and usually only temporary.

2.1.8 The planting has to consider soil quality on the planting site in the future rootable area. The topmost layer down to a depth of 400 mm is the most important. If soil on the planting site does not match optimum conditions, it should be improved. Soil treatment is governed by ČSN 83 9011.

2.1.9 **Compacted ground** has to be adequately aerated to at least double the width of the planting pit itself.

2.1.10 Where ground is raised by **backfilling, ground modulation and similar interventions**, the surface on which the backfill is applied has to be coarsened (e.g., by tillage) and the bottom soil layers aerated if necessary.

2.1.11 **Extremely windy sites.** On these sites, avenue tree transplants may suffer trunk breakage, tilting, or slower rooting. It is advisable to choose smaller-sized transplants for the planting and an adequate anchoring type.

2.1.12 Planting of trees in the **shade** directly under crowns of grown-up trees is

inappropriate, except in species tolerant to shading (see Annex 4).

2.2 Spatial conditions of site for planting

2.1.2 **Selection of the site** for planting a tree is preceded by a survey of location of technical utility networks (underground cables, overhead power lines, pipelines, etc.) in the area. Protective zones of technical utility networks are specified in Annexes 9 and 10.

2.2.2 Planting of trees within **protective zones of utility networks** is not possible. Possible exceptions, after an agreement with the utility manager, are temporary plantings and plantings using special technical solutions that prevent root growth towards the utility network line (see 4.9.5 through 4.9.7 below).

2.2.3 Planting of trees in **flood-prone areas** in an extent affecting the drainage conditions requires a permit pursuant to Act no. 254/2001 Coll.

2.2.4 Trees and shrubs must not be planted in the **road protective zone** on the inner side of a 1st or 2nd class highway or local road curve with a radius of 500 m and less, and inside the viewing triangles of intersections of such roads. The sides of viewing triangles are 100 m for main roads and 55 m for auxiliary roads.

2.2.5 Roadside vegetation on auxiliary land to roads and other suitable land comprising parts of motorways, highways or local roads may only be planted at a distance where it does not pose a solid obstacle pursuant to Act no. 13/1997 Coll. and standard regulations (see Annex 11 and Annex 12).

2.2.6 Planting of trees must not endanger road use safety or inadequately complicate the use of said land for the purpose of road maintenance, and must not inadequately complicate management of adjacent land plots. Specific procedures for establishment of roadside vegetation are provided in SPPK A02 010.

2.2.7 The distance of a solid obstacle (for example, a tree) from the hard shoulder of a road may change, while respecting legislative rules, in the case of an existing or newly installed road crash barrier (see Annex 12).

2.2.8 **Space for aboveground tree portions.** The site for planting has to allow the development of a crown to the dimensions of a grown-up individual in the taxon. Exceptions may include plantings of trees for further shaping and temporary plantings. Surrounding buildings, street furniture, aboveground utility networks, surrounding woody plants, etc., have to be taken into consideration.

Any necessary pruning intervention in crowns of existing trees or removal of other vegetation are part of the planting technique.

2.2.9 The **distance between planted trees** (pitch) has to correspond to the target dimensions of the crown of the grown-up tree in the taxon. In deliberate planting at a denser pitch (e.g., when establishing stands), the technical report has to define the necessity of follow-up pruning.

2.2.10 The **rootable area** is the necessary area that the planted tree can use for growing its root system. The cubic capacity has to correspond to the taxon dimensions, in both the qualitative and quantitative sense. Pursuant to ČSN 83 9021, the area that is uncovered or covered with material permanently permeable for air and water has to be at least 6 m^2. The area for the root system should have a basic size of at

least 16 m^2 and a depth of at least 800 mm.

Rootable soils are such that provide conditions for tree growth and development.

2.2.11 If the rootable area size is insufficient, technical solutions for expanding it have to be designed (e.g., use of structural substrates as part of the structural layers of paved areas, construction of root tunnels, connecting trenches, green belts, installation of aeration systems, etc.); see Annex 14, Figure 4.

2.2.12 Special requirements for the choice of taxon resulting from the characteristics of the planting site and the required function of the tree have to be respected (specific underpass clearance, maximum grown-up tree height, etc.).

2.2.13 If the rootable area does not conform to 2.2.10 above, the planting is usually temporary.

2.2.14 **Planting of trees in the immediate vicinity of shared boundaries of land plots** is handled by the Civil Code (Act no. 89/2012 Coll.). Unless a different legal regulation or local custom specifies otherwise, the permissible distance from shared boundaries of land plots is 3 m for planting of trees usually growing to a height in excess of 3 m, and 1.5 m for other trees. That said, the future growth of tree trunks has to be considered when planting, i.e., trees should be planted a bit beyond that limit depending on the thickness of their future trunks.

This does not apply if the neighbouring land plot is a forest or an orchard, if the trees make up the fence or if the tree in question is specially protected pursuant to another legal regulation.

2.3 Taxon selection for planting according to site conditions

2.1.3 In places with higher water table and on sites with impermeable horizons with water accumulation where the drainage conditions cannot be improved by drains, taxa tolerant to such conditions have to be preferred.

2.3.2 **Woody plant selection according to site temperature conditions.** The basic procedure for taxon selection for a specific site is a site survey and assessment of condition of woody plants growing there. This has to consider the site altitude as well as other conditions – solar and wind exposure, landscape topography, etc.

2.3.3 **Frost-resistance.** Frost-resistance is the primary limiting factor for woody plant selection. A hardiness zone classification has been made (see Annex 8). The frost-resistance of a taxon on a specific site has to be verified. Conversely, woody plants from cooler areas may suffer from overheating, drought and lower air humidity.

2.4 Taxon selection for planting in open country, rural settlements and peripheral areas of larger settlements transitioning into open country

2.1.4 The selection of taxa for planting in open country has to consider the nature of natural vegetation and the cultivated landscape. It is advisable to use species corresponding to the natural woody plant composition in the region (including rarer species), as well as woody plant species traditionally used in the area. With respect to maintenance of natural genetic variability, it is also advisable to use

local (regional) sources of planting material, particularly for the rarer species, and restrict the use of cultivars.

2.4.2 Use of introduced species is not desirable, with few exceptions. Pursuant to Section 5, Para. 4 and 5 of Act no. 114/1992 Coll., planting of introduced plant species and crossbreeds in open country is only possible with the permission of a nature protection authority. Woody plants with a certificate of origin or a cover sheet for planting material are preferred.

2.4.3 Pursuant to Section 16, Para. 1, item (h); Section 26, Para. 1, item (d); Section 29, item (e); and Section 34, Para. 1, item (d) of Act no. 114/1992 Coll., the use of introduced plant species for planting is prohibited in national parks, protected landscape areas, national nature reserves and nature reserves. In justified cases, an exemption from the Act can be granted pursuant to Section 43. Cultivation of crossbreeds in these categories of specially protected areas is only possible with permission of the applicable nature protection authority pursuant to Section 5, Para. 5. It is advisable to promote indigenous broadleaved trees species to the detriment of conifers.

4.4.2 When planting introduced woody plant species in open country (e.g., when restoring historic composed landscape areas, parks and cemeteries or in reclamation of devastated areas), invasive woody plants and woody plants with a high invasive potential on the site must not be used (see Annex 5). Woody plants with a certificate of origin are preferred.

2.4.5 When selecting woody plants for planting in historic gardens, parks, sites around historic monuments, etc., it has to be considered in particular whether they are located in a heritage reserve, heritage zone, the protective zone of an immobile cultural monument, immobile national cultural monument, heritage reserve or heritage zone. The reason is that in said areas, pursuant to Section 14, Para. 2 of Act no. 20/1987 Coll. on State Heritage Management, planting requires a prior binding position statement of a heritage management authority, because planting of woody plants in such cases is assessed for aesthetic, historic and composition aspects.

2.4.6 Planting in areas where restoration of completion of an existing green (avenues, parks, around sacral architecture, etc.) is in progress should prefer, in order to maintain the continuity, the same taxa, of broadleaved woody plants in particular, that are already present, unless they are invasive species or species inappropriate for the site.

2.5 Taxon selection for planting in urbanised areas and specific conditions

2.1.5 **Planting in urbanised areas.** The principal issue to consider is the taxon's ability to survive on the site while optimally performing the required functions. The use of introduced species and cultivars it therefore frequent; only the use of taxa with an invasive potential is restricted (see Annex 5).

2.5.2 **Planting around schools, kindergartens, playgrounds and similar areas with intensive presence of children.** Necessary considerations for these areas relate to planting of woody plants that are poisonous, allergenic, thorny and those with fragile wood. Their use has to reflect the attractiveness of their poisonous parts

and accessibility of the plants (see Annex 6). Pursuant to Section 77 of Act no. 258/2000 Coll., a public health protection authority has to provide its statement on the use woody plants in such areas.

2.5.3 Planting of host woody plants in areas with **presence of quarantine pathogenic organisms** should be considered. The State Phytosanitary Administration provides an up-to-date list of quarantine pathogenic organisms and their host plants.

2.5.4 Planting **along roads** should use taxa with respect to the techniques and extent of winter road maintenance. Taxa more tolerant to salt application are preferred. Tree species sensitive to salinity are listed in Annex 7.

3 Requirements for planted trees (quality indicators)

3.1 Nursery-cultivated plants

3.1.1 Tree transplants have to conform to the quality indicators under ČSN 46 4902.

3.1.2 Data on tags (species, cultivar, size, quality, number of transplants, number of units in pack, total number) have to correspond to reality. Plants shall be delivered in accordance with purchase order and delivery note.

3.1.3 Tree transplants have to be healthy, with no signs of damage to trunk and main branches, with mature shoots, free of disease and pest. They have to conform to their taxon characteristics. The maximum diameter of wounds not callused is 20 mm; the one-third rule has to be respected (see SPPK A02 002 – Pruning of trees).

3.1.4 Increased attention has to be paid to roots, root ball and root collar. At least 1% of randomly selected tree transplants can be carefully checked and inspected (for trees supplied in containers or with root ball, including possible disassembly of the root ball or container). The following parameters in particular are determined:

- wounds left by root breakage (maximum wound diameter 30 mm);
- sufficient number of evenly distributed main and fine auxiliary roots with respect to taxon-specific properties;
- roots must not be too dry, without visible symptoms of fungal infection;
- position of root collar within the ball (must not be below ground level ("sunken") or above the ball).

3.1.5 The earth ball has to be of adequate size and consistent. The root ball in a container has to be sufficiently developed.

3.1.6 The quality and composition of substrate in the root ball or container has to meet taxon-specific needs. If using substrates with a higher peat content, increased periodic watering is necessary during storage and after planting until proper rooting.

3.1.7 Dry roots, significantly damaged roots, damaged trunk, missing or damaged terminal bud (if developed by the taxon), crown not appropriate for the taxon and transplant size, are reasons for refusing to accept tree transplants.

3.1.8 If the main roots of container plants curve around the container wall, the material is non-standard. Such damaged plants should not be used. Curving auxiliary roots can be adjusted by pruning (see 4.2.4 below).

3.1.9 When planting trees with the earth ball, the mesh protecting the ball has to be made of annealed mesh with no surface finish. The cloth protecting the earth ball has to be made of a natural, easily degradable material. Trees with root balls wrapped in materials non-compliant to this specification are non-standard material and pose a reason for refusing to accept them.

3.1.10 Tree seedlings cannot be grown in containers, airpots or using similar techniques in the long-term.

4 Planting

4.1 Planting material transport and care

4.1.1 **Planting material handling.** Trees with a root ball should ideally be handled by the root ball. If they are gripped by the trunk (just over the root ball), the trunk has to be protected from mechanical damage.

4.1.2 The handling must not result in damage to the root ball or trunk tissues, breakage of buds or of main branches. Preservation of the terminal bud is of fundamental importance.

4.1.3 **Transport.** Trees have to be protected from drying, overheating and frost. Conditions that will protect trees from such damage have to be provided during transport.

4.1.4 Trees may only be dispatched with the recipient's consent[1] if the following conditions are met:

- between 1 October and 15 March at temperatures below -2°C,
- between 16 March and 30 September at temperatures below -1°C,
- if there is a danger of temperatures above 25°C.

4.1.5 Trees should ideally be planted immediately after transport.

4.1.6 **Planting material storage.** If plant material has to be stored on the construction site after transport, it has to be deposited in an adequate location, protected from wind, sun, frost and drying. The root systems of transplants or root balls have to be covered with moist sand, topsoil, peat, wood chips, compost or jute bags or matting.

4.1.7 Bare-rooted trees have to be stored immediately after transport. The only exception is plants with the root system treated with gel preparations, which have to be stored within 24 hours. Trees with root balls and in containers have to be temporarily stored within 48 hours after transport at the latest.

4.1.8 Stored plants have to be watered sufficiently depending on the weather and cover material used and protected from damage by wild animals depending on the site.

4.2 Treatment of roots

4.2.1 When planting **bare-rooted plants**, all damaged or dried roots have to be removed or shortened. Strangling roots shall also be removed. Long roots that would be deformed on insertion in the planting pit shall be shortened.

4.2.2 If roots of bare-rooted plants show signs of drying, they have to be dipped in water for at least an hour before planting. The maximum dipping time is 24 hours.

4.2.3 It is not necessary to treat wounds left after root shortening. Roots of bare-rooted trees with a trunk circumference over 140 mm should be treated with an anti-

1 Temperatures are measured at 8.00 am on the dispatch day.

desiccant (product protecting against drying).

4.2.4 In **container trees**, auxiliary roots curving along the container circumference have to be cut in at least two places on the sides and at the bottom; roots growing out of the container shall be removed (see Annex 14, Figure 5). Curving main roots are impermissible. All strangling roots have to be removed. A tree that has been seriously injured by removal of strangling roots (see 3.1.4 above) must not be planted.

4.3 Site modification

4.3.1 The future rootable area of the site has to be properly prepared before the commencement of planting. The preparation concerns primarily the following:

- removal of persistent weeds, including their vegetative parts capable of regeneration;
- removal of undesirable materials and replacement of contaminated of inappropriate soil as necessary;
- site modification, including backfilling with a vegetative soil layer as necessary (see 2.1.10 above).

4.2.3 Large-scale weed removal from the site is done either mechanically or using herbicides. Herbicides used have to be included on the List of Registered Plant Protection Products, and must not damage the planted trees.

4.3.3 Nutrients have to be released slowly, nitrogen in particular. Fertiliser doses have to conform to ČSN 83 9051.

4.4 Planting pits

4.4.1 On unaltered, uncompacted sites, the size of the planting pit is defined by the diameter of the root ball or container or the width of the root system of a bare-rooted plant. The width of the planting pit is at least 1.5 times the above dimension.

4.4.2 The shape of planting pits in sandy or medium-heavy soils is not important. In clayey or compacted soils, an angular or radial shape is more appropriate (see Annex 14, Figure 6-7).

4.4.3 The walls of the pit have to be coarsened and must not pose an impermeable obstacle for roots. The bottom of the planting pit must not be smooth and compacted; it has to be disrupted.

4.4.4 The depth of the planting pit should not exceed the size of the root ball or root system of the transplant.

4.4.5 Soil layers should not be mixed while digging the pit. The topmost layer should be separated from the lower layers (see Annex 14, Figure 3). The bottom of the pit has to be treated so as to prevent subsequent drop of the root collar of the planted tree.

4.4.6 No organic material (or residue of turf from topmost layers) should be mixed in earth coming from the lower layers, if further used for straying under the root ball

(see 4.6.11 below).

4.4.7 The term “lower soil layer” refers to a layer approximately below 0.3 m and 0.4 m in heavier and lighter soils, respectively.

4.4.8 Drainage conditions in the pit have to be checked before the planting. In areas with higher water table or on impermeable sites, excess water has to be removed via drains (see Annex 14, Figure 8) or plant above ground level (see Annex 14, Figure 9). When planting above ground level, earth has to be brought to the site in good time ahead of the planting.

4.4.9 In machine-dug pits, the compacted walls and bottom of the pit have to be disrupted before the planting.

4.4.10 Planting in trenches is possible when planting hedges and tree walls, slope planting, etc.

4.4.11 Safety measures when making planting pits has to comply with Government Regulation no. 591/2006 Coll.

4.5 Planting season

4.5.1 Bare-rooted trees and trees with a root ball shall be planted when the plant is in vegetative rest. Planting during frost and in frozen soil is prohibited.

4.5.2 Trees with a root ball can also be planted in the growing season if they are prepared adequately.

4.5.3 Trees supplied in containers or airpots can be planted throughout the year, unless the soil is frozen. It is not advisable to plant trees in full growth at high temperatures.

4.6 Planting procedure

4.6.1 The tree’s root collar has to be placed flush with the ground or slightly above ground; it must not be covered. The exceptions are *Populus* spp. (the genus poplar) and *Salix* spp. (the genus willow), whose root collar can be placed slightly below ground to promote the growth of adventitious roots.

4.6.2 The root collar of a tree planted on a slope has to be at the bottom edge of the removed ground (upper edge of the lower-lying pit wall). Trees planted on a slope have to be protected from water erosion (see Annex 14, Figure 1).

4.6.3 Roots or the top of the root ball have to be covered with a soil layer at least 20 mm thick after the planting.

4.6.4 Roots of bare-rooted plants have to be evenly spread by hand.

4.6.5 Wire meshing of the root ball has to be loosened at the top, and the top fastening wire has to be snipped open (Annex 14, Figure 10).

4.6.6 The actual position of the root collar in the ball or container has to be checked. If the tree is sunken in the root ball, earth from the top of the ball has to be removed and the collar set as per 4.6.1.

4.6.7 Watering as part of the planting is done into the open pit to minimise formation of air pockets. The watering has to evenly saturate soil throughout the planting pit.

4.6.8 Water used for the watering must not be contaminated and has to conform to ČSN 75 7143. Its quality has to be checked periodically.

4.6.9 Irrigation using irrigation probes is only effective in areas with limited water absorption capacity. If irrigation probes are installed, they have to be filled with gravel or similar suitable material. The use of irrigation probes in open unpaved areas is not necessary.

4.6.10 It is advisable to install anchors in the pit bottom before backfilling it (see 4.8 below).

4.6.11 Earth from the lower layer shall be used for backfilling the deeper portions of the pit (possibly improved with mineral substrate). Top-layer earth shall be used for backfilling the upper portions (possibly improved with mineral or even organic substrate).

4.6.12 When planting bare-rooted trees, proceed in a way to prevent formation of air pockets not filled with substrate among the roots.

4.6.13 Build irrigation bowls for improved tree watering ability. The exception is planting in areas where an irrigation bowl cannot be built (paved areas, etc.).

4.6.14 Any interference that might damage the root system after the planting is undesirable. These include, for example:

- deep loosening of the planting area by spading or machine soil processing;
- inconsiderate planting of other plants at the tree planting site;
- installation of stakes or anchoring systems in the immediate vicinity of the tree's root system after planting;
- installation of planting site protections, such as protective barriers, grilles, trunk grating, etc.

These works have to be carried out before the planting or as part of the planting.

4.7 Use of substrates and substances improving the site

4.7.1 Under good soil conditions, there is no need to replace or improve the soil in the planting pit.

4.7.2 Under impaired conditions, it is advisable to improve the soil. It is advisable to add only individual components to produce a substrate on the site by mixing with existing earth. Existing earth must not be contaminated.

4.7.3 Physical properties of heavier soils, more loaded sites (risk of soil compaction) and urbanised sites (paved areas – impaired intake of water and air) shall be improved with materials improving soil permeability (such as sand, crushed stone aggregate, mineral substrates). Conversely, clay or bentonite can be added to sandy soils to improve the water binding capacity of the substrate.

4.7.4 Unless the soil is significantly contaminated, earth on the site shall be improved only, thus preventing a fundamental change of structure and physical properties of surrounding soil. On ordinary sites, soil improvement is made only up to 50% of the capacity of the planting pit.

4.7.5 **Mineral substrates** are based on sand, gravel or other uncompressible materials (liapor, keramzit, recycled brick, etc.) mixed with existing earth. These materials must not fundamentally alter the site pH.

4.7.6 Mineral substrates may only be used in the bottom and top layers of the planting pit.

4.7.7 **Structural (load-bearing) substrates** are not used directly inside the planting pit but in the rootable area adjoining it. They are substrates capable of supporting (bearing) the building structure after compaction but provide suitable conditions for root growth at the same time. They consist of coarser fractions of gravel and other material suitable for root growth.

4.7.8 **Organic substrates.** These are substrates with a predominance of organic components (particularly compost, composted bark, peat). They can only be used for soil improvement in the topmost layer of 0.2–0.4 mm. Compost added to the substrates has to be well-decomposed.

4.7.9 Other auxiliary components may be added to the soil (substrate), such as water absorbents, root stimulators and fertilisers.

4.7.10 **Water absorbents** adjust the hydraulic regime, increase sorption of water and nutrient, promote microbiological activity in soil. They improve water management on the site. Their use is effective primarily on sandy soils or on altered sites with limited water ingress.

4.7.11 **Stimulators** promote root growth and accelerate the development of a new root system.

4.7.12 **Mycorrhiza** allows roots to better absorb water and nutrients; mycorrhizal fungi provide plants with some growth hormones. More efficient nutrient absorption improve tree vitality. It is advisable to use mycorrhizal preparations exclusively in the planting pit, particularly on degraded sites, which have a lower probability of their natural occurrence.

4.8 Anchoring

4.8.1 Maiden whips and pyramids from 1.5 m high and trees with a cultivated crown have to be firmly anchored during planting to prevent ripping of roots when the aboveground portion moves.

4.8.2 The type of anchoring, size and strength of stakes are chosen with respect to the plant size, expected duration, nature and function of uses in the area (for example, traffic safety requirements), the site and aesthetics. Typically the anchoring is done with 1-3 stakes (see Annex 14, Figure 11).

4.8.3 The anchoring must not damage the tree.

4.8.4 Anchoring is usually kept for two growing seasons; exceptions are plantings of

grown trees or plantings on windy or otherwise exposed sites.

4.8.5 Anchoring is most commonly done using stakes, rope systems in the crown or underground anchors.

4.8.6 **Stakes** used for anchoring have to be barked and have a service life of at least 2 years. Deep impregnation of stakes is advisable if there are requirements for longer durability.

4.8.7 **Ties** have to be secured against slipping on stakes. Ties must not damage the bark or hinder trunk widening.

4.8.8 Stakes are installed in an open planting pit during the planting so as not to damage roots. Stakes have to be embedded below the planting pit bottom. The anchoring height starts 500 mm above ground and extends to no more than 100 mm under the bottom of the crown in plants with a distinct trunk (see Annex 14, Figure 2).

4.8.9 When using **rope anchoring systems**, the system has to be inspected periodically. The ropes have to be taut enough. The ropes must not grow into bark tissues.

4.8.10 **Underground anchoring** can only be used in trees supplied with a root ball or in a container. Anchoring via the root ball can be used in intact balls of clayey or clay-loamy soils. Anchoring components must not cut deep into the earth ball (see Annex 14, Figure 12).

4.9 Special measures

4.9.1 **Grilles** are installed as one of the measures in areas with intensive pedestrian traffic and the soil in the root area may be trampled (compacted).

4.9.2 The size of the grille depends on the target size of the planted tree. For larger trees, split grilles are preferable as they allow increasing the hole for the trunk as it widens.

4.9.3 The grilles have to be fastened in a way that does not prevent roots from growing into the surrounding soil. Grilles are mounted on beams laid on footings.

4.9.4 Grilles have to be sufficiently permeable for water and air, and have to permit inspection of the root area, removal of litter and tree care. They should allow disassembly and be secured against theft.

4.9.5 **Root barriers** can be used for one-sided prevention of root system growth (for example, towards an obstacle). They have to be installed at a sufficient distance from the tree to permit development of a stable root system, and to a sufficient depth (0.5–1.5 m) depending on the soil conditions and root system type of the tree.

4.9.6 Root barriers are always installed with the front facing the trunk. Their installation and backfilling must not result in damage or rupture.

4.9.7 Underground utility networks are ideally protected by means of protectors.

4.9.8 **Irrigation systems** may be installed on sites where sufficient quantity of natural water for the tree growth cannot be expected. The irrigation has to stimulate root growth into deeper soil layers, and the quantity of water supplied has to match the irrigation type, woody plant size, soil conditions, time of day and season.

4.9.9 **Crash barrier installation**. On slopes and embankments, where crash barriers are defined by a standard or installed based on other requirements, trees can be planted if it respects the sufficient necessary distance from the obstacle and necessary distance for crash barrier deformation upon impact (deformation zone). Installation of crash barriers is governed by Decree no.104/1997 Coll. and regulations specified in Annex 12.

4.9.10 **Protection from parking** is used in areas where vehicles run and park close to trees.

4.9.11 Protection of trees from parking typically uses metal or concrete elements firmly embedded in the ground and resistant to damage. They have to be installed at least 0.7 m from the tree trunk, be sufficiently visible and they must not damage the tree in any way.

4.9.12 Parking barriers have to comply with requirements of ČSN EN 12899–1.

4.9.13 In areas where **brine may bespatter the trunk or crown** due to winter road salting, it is advisable to consider installation of adequate plant protection. The protection has to effectively prevent contact with dissolved road salt.

4.9.14 All the installed elements have to be placed so as not to damage the tree and permit its thickness increments. They have to sufficiently embedded. The embedding has to be outside the planting pit and its restriction on the rootable area should be minimised.

4.10 Mulching

4.10.1 Planted trees should be mulched with a layer of mulching material 80-100 mm thick. The mulch should not be in direct contact with the trunk.

4.10.2 Mulching materials must not damage the tree and their properties must not prevent air and water absorption by the soil.

4.10.3 Mulch can be the following **organic materials** for example: bark, wood chips, straw. Grass and other plant remains are not suitable, as they ferment.

4.10.4 The most suitable **inorganic material** is crushed gravel (fraction 4–8 mm up to 32–64 mm). Keramzit, liapor and similar materials can be used as mulch too.

4.10.5 On exposed sites, where surface trampling (compaction) is a threat, crushed gravel is the optimal mulch. Gravel of larger fractions (e.g., 32–64 mm) is suitable for sites with heavier pedestrian traffic.

4.10.6 Mulching fabrics made of both natural and artificial fibres and mulching sheets can also be used.

4.10.7 The different mulching techniques can be combined.

4.10.8 Mulch is applied so that the root bowl area maintains its gentle gradient towards the trunk.

4.11 Tree protection

4.11.1 Adequate trunk protection installation is advisable when planting trees with distinct trunks.

4.11.2 Protection from **bark scorch** is done using reed, bamboo or straw mats. The use of jute bandaging is not recommended. Trunks can also be coated with whitewash or special preparations.

4.11.3 In areas where planted woody plants are threatened by **gnawing, browsing or antler damage**, the plant has to receive suitable protection. In addition to mechanical protection (such as sleeves, fences), repellent coating or spraying is also possible. The coats or sprays have to be applied in accordance with public health regulations and traffic safety principles on the site.

4.11.4 The protective coats and sprays used have to be included on the List of Registered Plant Protection Products (Decree no. 32/2012 Coll.).

4.11.5 The **root area** can be protected from ingress of contaminated water by raising the kerbs or use of protective barrier.

4.11.6 In lawn areas, it is advisable to install protective elements against **trunk damage by mowers**. An appropriate protection from trunk damage by mowers is maintenance of a protective area around the trunk (e.g., application of mulch).

4.11.7 The trunk protection must not damage the woody plant and has to be installed with a sufficient leeway to permit trunk widening.

4.11.8 In trees planted in summer on sites with extreme sunshine and high temperatures (such as paved areas), it is advisable to protect the crown with a special mesh (shading mesh) during summer. The shading mesh has to be removed by mid September at the latest.

4.12 Pruning during planting (comparative pruning)

4.12.1 Performance of comparative pruning is governed by SPPK A02 002 – Pruning of trees.

4.13 Planting acceptance

4.13.1 The warranty period for the planting works is agreed as part of the contractual relationship between the planting contracting authority and the contractor, and shall cover the period of abatement of the trees' post-transplant shock. The period of abatement of the post-transplant shock is determined pursuant to 5.3.3 below.

4.13.2 The optimum period for work acceptance is June to August.

4.13.3 The acceptance procedure includes inspection of:

- genuineness of the declared taxon,
- declared plant size,
- physiological vitality and health condition of the tree,
- crown cultivation type,
- treatment of root bowl and rootable area,
- permanent protective elements installed.

5 Finishing and development management after planting

Finishing management proceeds from the planting execution to the work handover and acceptance by the contracting authority. Development management proceeds from the handover during the phase of abatement of post-transplant shock, and in a reduced form, throughout the tree's further growth until it becomes fully functional. Development management is followed by follow-up management, which is provided throughout the tree's life.

5.1 Juvenile pruning

5.1.1 Juvenile pruning is governed by SPPK A02 002 – Pruning of trees.

5.2 Inspection and removal of anchoring and protective elements

5.2.1 Aboveground anchoring has to be inspected at least once a growing season for at least two years. The inspection includes its repair or adjustments to prevent damage to the trunk and ensure optimum functioning. The anchoring is usually removed after two years.

5.2.2 Trunk protection elements have to be inspected at least once a year. The protective elements have to be repaired and loosened. Coating and spraying against browsing damage have to be renewed annually.

5.3.2 Shading mats are usually removed after two years; they can be left for long in justified cases (e.g., along roads with chemical winter maintenance). Protection from browsing, gnawing and antler damage has to be maintained for longer (until the tree produces a coarser bark), particularly in sensitive taxa such as apple trees.

5.3 Watering

5.3.1 The watering bowl has to be maintained for at least two years, and then throughout the watering period.

5.3.2 The quality of water used is governed by 4.6.8 above.

5.3.3 Watering is provided for the period of abatement of the post-transplant shock. The length of the post-transplant shock can be determined approximately as 1 year per 80 mm of trunk circumference (rounded upwards). This rule does not apply to extreme sites, where specific conditions dictate provision of watering until proper rooting; in some cases (e.g., sites without a connection of the root area to natural ground), throughout the entire existence of the tree on the site.

5.3.4 Earth moisture has to be checked before application of watering. The soil around the planting pit must not become too wet.

5.3.5 The watering has to be adjusted to the climate conditions, the site (e.g., effect of site exposure to wind or sunshine), current weather, size of tree planted, soil moisture, date of execution (some species require abundant watering before

winter) and taxon-specific requirements. A cycle of 6–8 waterings in the course of the first growing season after planting is mostly recommended. The frequency of watering decreases to 3–6 in the second year.

5.3.6 Watering has to penetrate the depth of the root area (depending on tree size) throughout the planting pit. This has to be reflected in the quantity of water in each watering (see approximate recommendations in Annex 13).

5.3.7 Watering must not be done using water under pressure, to prevent soil washout and worsening of soil physical properties.

5.4 Fertilisation

5.4.1 Fertilisation should only be done to the necessary extent depending on the nutrient content in the soil. That is determined by analysis and assessment of expressions of plant vitality (increment length, leaf size and colour, annual shoot maturity, etc.). The use of slow-dissolving fertilisers is preferable. If quick fertiliser effect is necessary, fertilising watering or leaf fertilisation can be used.

5.4.2 Fertilisation is used primarily when trees are exposed to stress (for example, due to damage, disease or pests, adverse climate conditions, etc.), to support their recovery ability.

5.4.3 Always consider the correct method of application and correct dosage based on the fertiliser type used.

5.4.4 The use of fertilisers with a nitrogen content above 5% is inappropriate after 15 August.

5.5 Loosening

5.5.1 Loosening is done at trees that have not been mulched.

5.5.2 Loosening is done after watering to disrupt the soil crust, allow easier air access to soil, and disrupt soil capillarity leading to water retention in soil. Loosening is accompanied by weeding.

5.5.3 Loosening is done to a depth of 30 mm in a way not to damage the root collar and roots of the tree and any undergrowth planting.

5.6 Weeding

5.6.1 Weeding is done to remove undesirable plants from the planting area.

5.6.2 Weeding can be done chemically or mechanically.

5.6.3 Chemical weeding may only use products approved for the purpose, such that do not threaten the treated trees in any way.

5.6.4 The application must not affect or damage any other plants in the surroundings of the treated woody plant; the products must not stain tree trunks. Any and all occupational health and safety rules have to be observed. The work always has to

proceed with the knowledge of and in accordance with the owner and the investor.

5.6.5 Any and all application has to be recorded in the construction journal or another adequate document. Each entry shall include the name of the substance applied, the dose used, the application method, the weather, names of employees doing the application, the hour of the day in which the work was done. These entries have to be confirmed by the client.

5.6.6 In mechanical weeding, undesirable plants are either plucked or the aboveground portion is separated from the roots by hoeing, or the weeds are mowed.

5.6.7 The work always has to proceed carefully, to avoid damage to the root collar or roots of the plant being weeded or its undergrowth.

5.6.8 After weeding, the weeds are removed and taken away, unless there is a different arrangement with the investor.

5.6.9 Use of herbicides may be regulated in specially protected areas, protective zones of water sources, or by local regulations.

5.7 Protection from disease and pests

5.7.1 The overall condition of the woody plants has to be inspected during vegetation. If any infection is detected, the pathogenic organism has to be identified and adequate measures have to be taken depending on its type and degree of danger.

5.8 Protection from effects of frost

5.8.1 Thermophilic taxa in particular are protected from frost, primarily in early stages of development, if planted in conditions colder than their natural habitats.

5.8.2 The most important measure for evergreen taxa is provision of sufficient quantity of water in the soil before the onset of frost. The effect of watering can be increased by application of materials with thermal insulation properties (e.g., mulch).

5.8.3 Trunks of sensitive tree species are protected by wrapping from effects of intensive sunshine in early spring with a danger of night frost, when there is a risk of frost plates and cracks.

5.8.4 Crowns of sensitive trees (conifers in particular) are protected, for example, by chemical products limiting evaporation or shading with special fabric, which have to be removed on time in spring.

5.9 Mulch replenishment

5.9.1 Natural products (particularly of organic origin) used for mulching are gradually decomposed and have to be replenished during finishing management.

5.9.2 Mulch replenishment up to the original level (4.10.1 above) is done once a year, ideally at the beginning of the growing season.

Annex 1 List of trees and tree-formed shrubs with an optimum on acidic soils above pH 7

Acer campestre	field maple
Amygldalus communis (*Prunus amygdalus*)	almond tree
Armeniaca vulgaris (*Prunus armeniaca*)	Tibetan apricot
Calocedrus decurrens	incense cedar
Carpinus betulus	common hornbeam
Cedrus atlantica	Atlas cedar
Cedrus libani	Lebanon cedar
Cerasus avium (*Prunus avium*)	wild cherry
Cerasus mahaleb (*Prunus mahaleb*)	mahaleb cherry
Cornus mas	European cornel
×Cupressocyparis leylandii	Leyland cypress
Elaeagnus angustifolia	Russian olive
Fagus sylvatica	European beech
Fraxinus excelsior	common ash
Fraxinus ornus	manna ash
Ginkgo biloba	ginkgo tree
Juglans regia	Persian walnut
Koelreuteria paniculata	varnish tree
Laburnum anagyroides	common laburnum
Larix decidua	European larch
Morus alba	white mulberry
Morus nigra	black mulberry
Ostrya carpinifolia	European hop-hornbeam
Paulownia tomentosa	foxglove tree
Picea omorika	Bosnian spruce
Pinus heldreichii	Bosnian pine
Pinus nigra	black pine
Pinus ponderosa	western yellow-pine
Platanus ×hispanica	London planetree
Platycladus orientalis (*Thuja orientalis*)	Oriental arborvitae
Populus alba	silver poplar
Populus simonii	Simon poplar
Pyrus pyraster	European wild pear
Quercus frainetto	Hungarian oak
Quercus pubescens	downy oak
Rhamnus cathartica	common buckthorn
Robinia pseudoacacia	black locust
Salix alba	white willow

Salix babylonica	Babylon willow
Salix daphnoides	European violet-willow
Sophora japonica	Japanese pagoda tree
Sorbus aria	common whitebeam
Tamarix spp.	tamarisk
Taxus baccata	European yew
Tilia platyphyllos	large-leaved linden
Ulmus glabra	wych elm
Ulmus laevis	spreading elm
Ulmus minor	field elm

Developed based on:

Hurych, V., 1996, 2003: Okrasné dřeviny pro parky a zahrady, Květ, ISBN 80-85362-19-8
Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.

Annex 2 List of trees and tree-formed shrubs tolerant to acidic soils (below pH 4)

The overwhelming majority of conifers	
Abies alba	European silver fir
Abies grandis	grand fir
Abies homolepis	Nikko fir
Abies koreana	Korean fir
Abies nordmanniana	Caucasian fir
Abies procera	noble fir
Abies veitchii	Veitch's fir
Acer saccharinum	silver maple
Betula pendula	white birch
Betula pubescens	downy birch
Castanea sativa	sweet chestnut
Chamaecyparis nootkatensis	Nootka cypress
Chamaecyparis pisifera	sawara cypress
Juniperus chinensis	Chinese juniper
Juniperus communis	common juniper
Juniperus virginiana	Virginian juniper
Larix sibirica	Siberian larch
Liriodendron tulipifera	tulip tree
Magnolia spp.	magnolia
Nyssa sylvatica	black tupelo
Padus avium (*Prunus padus*)	European bird cherry
Picea abies	Norway spruce
Picea glauca	white spruce
Picea mariana	black spruce
Picea sitchensis	Sitka spruce
Pinus banksiana	Jack pine
Pinus cembra	Swiss pine
Pinus koraiensis	Korean pine
Pinus parviflora	Japanese white pine
Pinus sylvestris	Scots pine
Pinus uncinata ssp. *uliginosa*	mountain pine
Populus tremula	quaking aspen
Pseudolarix amabilis (*P. kaempferi*)	golden larch
Quercus palustris	pin oak
Quercus rubra	northern red oak
Salix pentandra	bay willow
Sciadopitys verticillata	Japanese umbrella-pine

Sorbus aucuparia	mountain ash
Tsuga canadensis	eastern hemlock
Tsuga heterophylla	western hemlock
Taxodium distichum	bald cypress

Developed based on:

Hurych, V., 1996, 2003: Okrasné dřeviny pro parky a zahrady, Květ, ISBN 80-85362-19-8
Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.

Annex 3 Examples of taxa of trees and tree-formed shrubs that do not allow crown elevation by pruning

Acer campestre 'Compactum'
Acer platanoides 'Globosum'
Aesculus hippocastanum 'Umbraculifera'
Aesculus ×carnea 'Pendula'
Alnus glutinosa 'Pendula'
Betula pendula 'Gracilis'
Betula pendula 'Pendula'
Betula pendula 'Youngii'
Carpinus betulus 'Horizontalis'
Carpinus betulus 'Pendula'
Catalpa bignonioides 'Nana'
Cerasus avium 'Pendula'
Cerasus ×eminens
Cerasus mahaleb 'Pendula'
Cerasus serrulata 'Kiku–shidare–sakura'
Cerasus subhirtella 'Pendula'
Cerasus subhirtella 'Rosea'
Fraxinus excelsior 'Nana'
Fraxinus excelsior 'Pendula'

Morus alba 'Pendula'
Platanus ×hispanica 'Alphens Globe'
Robinia pseudoacacia 'Bessoniana'
Robinia pseudoacacia 'Umbraculifera'
Salix alba 'Tristis'
Salix caprea 'Pendula'
Salix matsudana 'Pendula'
Salix matsudana 'Umbraculifera'
Salix ×sepulcralis
Sophora japonica 'Pendula'
Sorbus aucuparia 'Pendula Variegata'
Sorbus aucuparia 'Pendula'
Tilia tomentosa 'Silver Globe'
Ulmus ×elegantissima 'Jacqueline Hillier'
Ulmus glabra 'Nana'
Ulmus glabra 'Pendula'
Ulmus minor 'Pendula'
Ulmus minor 'Umbraculifera'

Developed based on:

Hurych, V., 1996, 2003: Okrasné dřeviny pro parky a zahrady, Květ, ISBN 80-85362-19-8

Krüssman, G., 1978: Handbuch der Laubgehölze, Paul Parrey Verlag,Berlin und Hamburg; Auflage: 2. völlig neubearb. u. erw. Aufl. 19, ISBN-13: 978-3489574224

Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.

Annex 4 List of trees and tree-formed shrubs tolerant to shade

Abies spp.	fir
Acer campestre	field maple
Acer platanoides (young)	Norway maple
Acer pseudoplatanus (young)	sycamore
Carpinus betulus	common hornbeam
Chamaecyparis lawsoniana	Lawson cypress
Chamaecyparis obtusa	Japanese cypress
Fagus sylvatica	European beech
Fraxinus excelsior (young)	common ash
Padus avium (Prunus padus)	European bird cherry
Picea abies	Norway spruce
Pseudotsuga menziesii	Douglas fir
Sorbus aucuparia	mountain ash
Taxus baccata	European yew
Thuja occidentalis	eastern arborvitae
Thuja plicata	western arborvitae
Thujopsis dolabrata	false arborvitae
Tilia cordata	small-leaved linden
Tsuga canadensis	eastern hemlock
Tsuga heterophylla	western hemlock
Ulmus glabra	wych elm
Ulmus laevis	spreading elm
Zelkova serrata	Japanese zelkova

Developed based on:

Hurych, V., 1996, 2003: Okrasné dřeviny pro parky a zahrady, Květ, ISBN 80-85362-19-8
Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.

Annex 5 Introduced trees and tree-formed shrubs with an invasive potential

Tree with an invasive potential in the Czech Republic include the following, among others[2]:

Ailanthus altissima	tree of heaven*
Fraxinus pennsylvanica	green ash
Negundo aceroides (*Acer negundo*)	ashleaf maple*
Padus serotina (*Prunus serotina*)	rum cherry*
Paulownia tomentosa	foxglove tree
Pinus strobus	Weymouth pine
Populus ×canadensis	Canadian poplar
Quercus rubra	northern red oak*
Rhus typhina	staghorn sumac*
Robinia pseudoacacia	black locust
Syringa vulgaris	common lilac*

Developed based on:
Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.
Mlíkovský J., Stýblo P., eds., 2006: Nepůvodní druhy fauny a flóry České republiky, Praha: ČSOP, 496 pp.

2 Species marked with * are locally invasive or expected to become invasive.

Annex 6 Trees and tree-formed shrubs with attractive poisonous parts

Name	Poisonous part	Degree of toxicity[3]	Remark
Broadleaved woody plants			
Ailanthus altissima	seeds, bark	++	causes difficulties when cutting – headache, skin rash
Buxus sempervirens	whole plant	++++	
Euonymus spp.	whole plant	+++	36 fruits can be dangerous to adults
Gleditsia triacanthos	leaves	++	fruits and seeds are edible
Gymnocladus dioicus	leaves and uncooked seeds	++	roasted seeds historically used as coffee surrogate in North America
Ilex spp.	leaves and fruits	+++	20–30 fruits can be dangerous to adults
Laburnum spp.	whole plant	++++	3–4 pods can be dangerous to children
Laurocerasus officinalis	fruits	+++	
Prunus serotina	whole plant	++	
Rhamnus spp.	whole plant	++	
Robinia spp.	whole plant	+++	bark and fruits are particularly poisonous
Sophora japonica	bark, fruits and seeds	+++	pods are highly toxic
Conifers:			
Juniperus ×pfitzeriana	whole plant	++++	
Juniperus sabina	whole plant	++++	shoot tips are highly toxic; 5–20 g can be dangerous
Junuperus virginiana	whole plant	++++	
Taxus spp.	whole plant except succulent aril of the fruit	++++	needles particularly toxic, also for horses and cattle
Thuja spp.	whole plant	++++	toxic for animals, particularly horses

Developed based on:

Koblížek, J., 2006: Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.

Vlasák, M., 2012: Okrasné dřeviny, Vyšší odborná škola zahradnická a Střední zahradnická škola, Mělník, ISBN 978-80-904782-9-9

[3] The more +, the greater danger of poisoning.

Annex 7 List of important woody plants sensitive to salinity

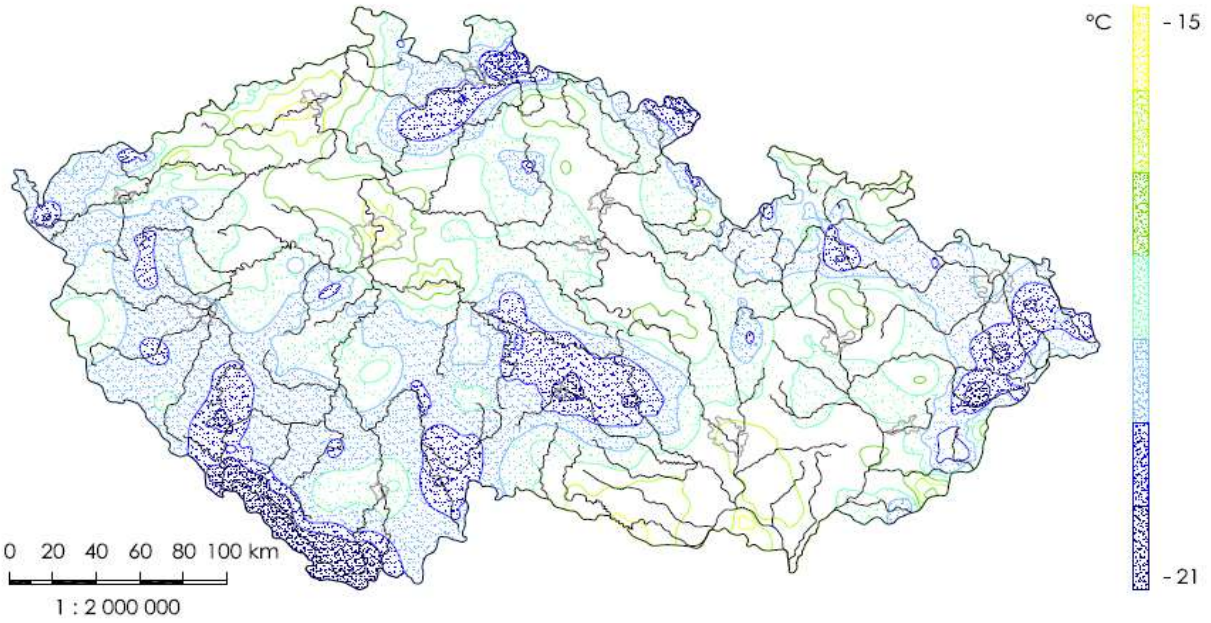
Abies spp.	fir genus
Acer pensylvanicum	striped maple
Acer platanoides	Norway maple
Acer pseudoplatanus	sycamore
Acer rubrum	red maple
Acer saccharinum	silver maple
Acer saccharum	sugar maple
Aesculus ×carnea	red horse-chestnut
Aesculus hippocastanum	horse chestnut
Alnus spp.	alder genus
Betula spp.	birch genus
Carpinus betulus	common hornbeam
Castanea sativa	sweet chestnut
Catalpa bignonioides	southern catalpa
Cedrus atlantica	Atlas cedar
Cercidiphyllum japonicum	katsura tree
Cercis canadensis	eastern redbud
Cornus mas	European cornel
Corylus colurna	Turkish hazel
Chamaecyparis spp.	cypress genus
Crataegus laevigata	midland hawthorn
Crataegus ×lavallei	hybrid cockspurthorn
Crataegus monogyna	single-seeded hawthorn
Fagus sylvatica	European beech
Juglans spp.	walnut genus
Laburnum ×watereri 'Vosii'	Voss's laburnum
Larix decidua	European larch
Liquidambar styraciflua	American sweetgum
Liriodendron tulipifera	tulip tree
Magnolia spp.	magnolia genus
Malus spp.	apple genus
Mespilus germanica	common medlar
Metasequoia glyptostroboides	dawn redwood
Morus alba	white mulberry
Negundo aceroides (Acer negundo)	ashleaf maple
Picea spp.	spruce genus
Pinus cembra	Swiss pine
Pinus peuce	Macedonian pine
Pinus strobus	Weymouth pine

Pinus sylvestris	Scots pine
Pinus uncinata	mountain pine
Platanus ×hispanica	London planetree
Populus balsamifera	balsam poplar
Populus nigra	black poplar
Populus simonii	Simon poplar
Populus tremula	quaking aspen
Prunus spp.	plum genus
Pseudotsuga menziesii	Douglas fir
Quercus rubra	northern red oak
Sorbus spp.	rowan genus
Taxodium distichum	bald cypress
Taxus baccata	European yew
Thuja spp.	arborvitae genus
Tilia spp.	linden genus
Tsuga canadensis	eastern hemlock
Ulmus glabra	wych elm

Developed based on:

Koblížek, J. (2006): Jehličnaté a listnaté dřeviny našich zahrad a parků. Sursum, Tišnov.
Pejchal, M., 2008: Arboristika I. Vyšší odborná škola zahradnická a střední zahradnická škola Mělník, Mělník.

Annex 8 Average annual minimum air temperatures



Plant hardiness zone	Temperature [°C]	Remark
Z1	below -45.5	
Z2	-45.5 to -40.1	
Z3	-40.1 to -34.5	
Z4	-34.5 to -28.9	
Z5	-28.8 to -23.4	
Z6	-23.4 to -17.8	Evergreen species have to be protected during black frost
Z7	-17.8 to -12.3	Evergreen species have to be protected during black frost
Z8	-12.3 to -6.7	Requires protection during frost, e.g., burying in leaves or spruce branches
Z9	-6.7 to -1.2	Requires intensive winter protection, e.g., using cloth
Z10	-1.2 to +4.4	Requires wintering in spaces without frost (5-15°C – conservatory, greenhouse)
Z11	above +4.4	

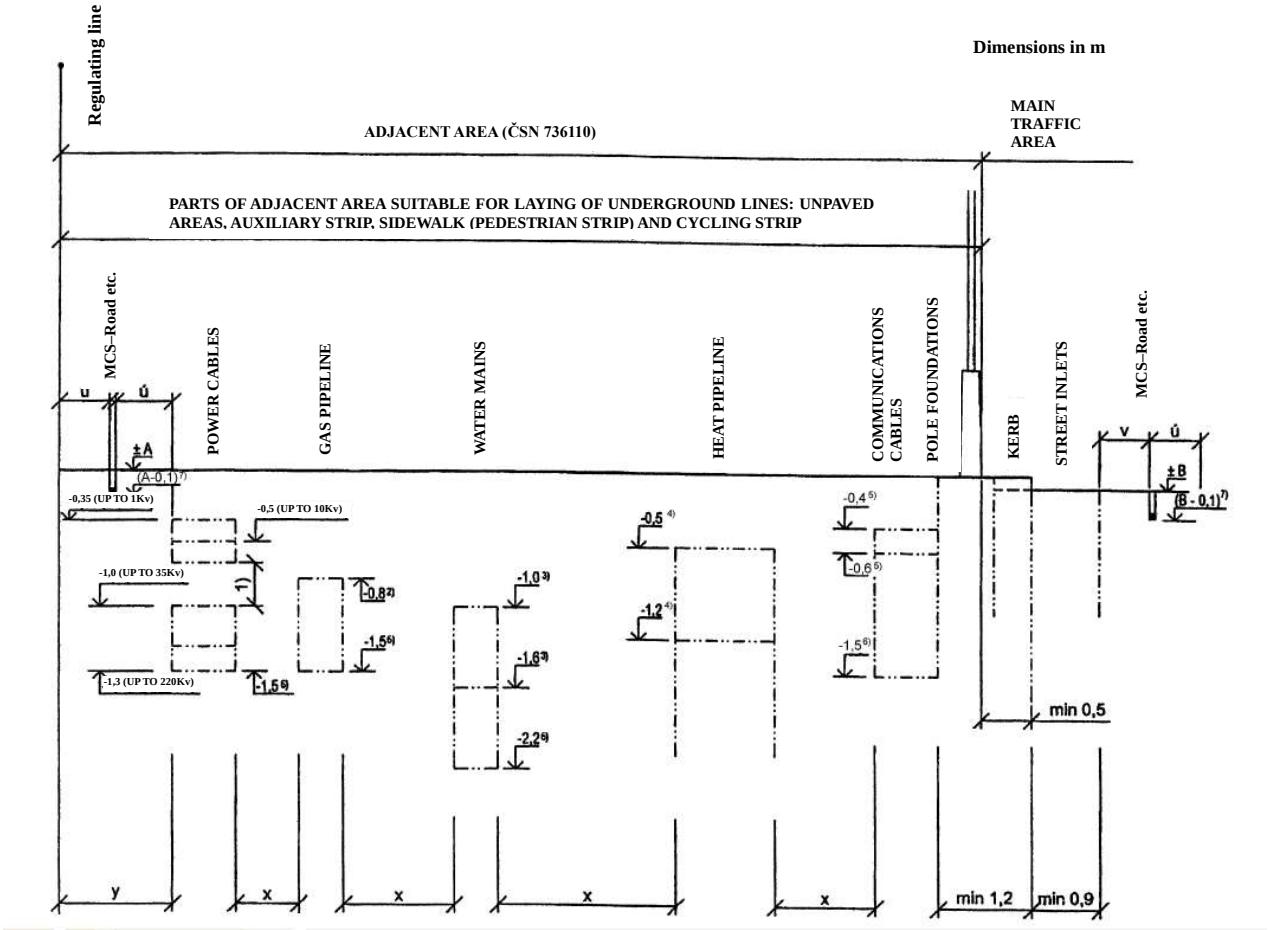
Developed based on:

Heinze, W., Schreiber, D., 1984: Eine neue Kartierung der Winterhärtezonen für Gehölze in Mitteleuropa. Mitteilungen der Deutschen Dendrologischen Gesellschaft 75, 11-56.

Tolasz, R. a kol., 2007: Atlas podnebí Česka, Český hydrometeorologický ústav, Praha, ISBN 978-80-86690-1

Annex 9 Space arrangement of conduits of technical equipment

Rules pursuant to ČSN 73 6005



x shortest permitted horizontal distance between conduits

y shortest permitted distance of power cables from buildings (ČSN 34 1050)

z shortest permitted distance of gas pipelines from buildings (ČSN 38 6410, ČSN 38 6413)

1. Space for connections
2. Roofing over low-pressure and medium-pressure gas pipelines 0.8 m
3. Lowest roofing from 1.0 m to 1.6 m (ČSN 75 5401, ČSN 75 5402)
4. Optimum roofing from 0.4 m to 1.2 m (ČSN 38 3360)
5. Lowest roofing for underground and surface cables is 0.4 m
6. Highest recommended roofing
7. Possible location of optical cables with trenchless technique MCS-ROAD, etc., laid in a cut groove approx. 10 mm wide and 100 mm deep.

Annex 10 Protective zones of conduits of technical equipment

Equipment type	Equipment	Specification	Restriction type	Distance	Measured from	Bans/restrictions	Reference
Power system equipment	Overhead lines	For voltages from 1kV to 35kV, inclusive	Protective zone (established on the day of legal power of zoning decision on project location or zoning approval to project location; if Building Code requires neither, then on the day of commissioning of power system equipment)		Outermost conductor	No vegetation growing taller than 3 m	Section 46 of Act no. 458/2000 Coll.
		- wires w/o insulation		7 m			
		- wires with basic insulation		2 m			
		- suspended cable lines		1 m			
		For voltages from 35kV to 110kV, inclusive					
		- wires w/o insulation		12 m			
		- wires with basic insulation		5 m			
		For voltages from 110kV to 220kV, inclusive		15 m			
		For voltages from 110kV to 400kV, inclusive		20 m			
		For voltages over 400kV		30 m			
		For 110kV suspended cable lines		2 m			
		For licensee's own telecom network equipment		1 m			
	Underground lines, control and security equipment lines	For voltages up to 110kV		1 m	Outermost cable	No planting of permanent vegetation and travel of machinery with total weight above 6 t over lines	
		For voltages over 110kV		3 m			

Equipment type	Equipment	Specification	Restriction type	Distance	Measured from	Bans/restrictions	Exceptions	Reference
Power system equipment	Power distribution station	Outdoor	Protective zone (established on the day of legal power of zoning decision on project location or zoning approval to project location; if Building Code requires neither, then on the day of commissioning of power system equipment)	20 m	Fencing or outer face of perimeter wall	No vegetation growing taller than 3 m		Section 46 of Act no. 458/2000 Coll.
		stations with voltage over 52kV in buildings		20 m				
		mast and tower stations with outdoor supply line and voltage transformation from between 1kV and 52kV to low voltage		7 m	Outer edge of station footprint in every direction			
		compact and masonry stations with outdoor supply line and voltage transformation from between 1kV and 52kV to low voltage		2 m	Outer station envelope in every direction			
		Indoor		1m	Walls			
	Power generating plant			20 m	Outer face of perimeter envelope			
Gasworks equipment	Low-pressure and medium-pressure gas line connections in built-up areas		Protective zone (established on the day of legal power of zoning decision on project location or zoning approval to project location; if Building Code requires neither, then on the day of commissioning of gasworks equipment)	1 m	Equipment footprint	No planting of permanent vegetation rooting deeper than 200 mm above gas line surface in an undeveloped strip of land extending 2 m on either side from gas line or connection axis	Consent of transport network operator, distribution network operator, gas tank operator or connection operator	Section 68 of Act no. 458/2000 Coll.
	Other gas lines and connections			4 m				
	Process equipment structures			4 m				

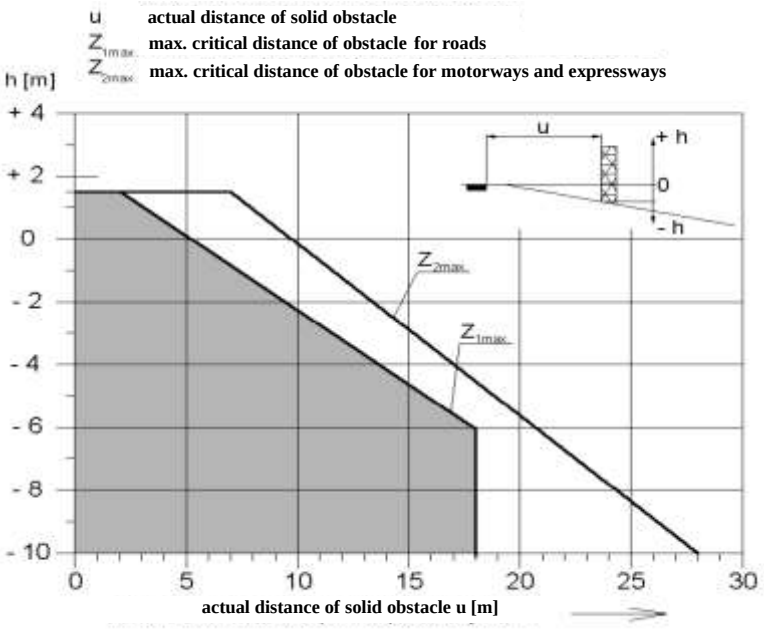
Equipment type	Equipment	Specification	Restriction type	Distance	Measured from	Bans/restrictions	Exceptions	Reference
Heat generating or distributing equipment			Protective zone (established on the day of legal power of zoning decision on project location or zoning approval to project location; if Building Code requires neither, then on the day of commissioning of heat generating or distributing equipment)	2.5 m	Equipment perimeter (footprint)	No planting of permanent vegetation	Written consent of equipment operator	Section 87 of Act no. 458/2000 Coll.
Communications lines	Communications lines	Overhead	Protective zone (established on the day of legal power of decision on project location, decision on protected area or protective zone)	Pursuant to decision on project location, decision on protected area or protective zone				Sections 102 and 103 of Act no. 127/2005; Act no. 183/2006 Coll.
		Underground	Protective zone (established on the day of legal power of decision on project location)	1,5 m	Outermost line	No planting of permanent vegetation	Owner's consent	
	Radio equipment and radio distribution lines		Protective zone (established on the day of legal power of decision on protected area or protective zone)	Pursuant to decision on protected area or protective zone				

Developed based on:
Act no. 458/2000 Coll. on Requirements for Business and Public Administration in Energy Industries and on amendment of certain acts (Energy Act).
Act no. 127/2005 Coll. on Electronic Communications and on amendment of certain acts (Electronic Communications Act).
Act no. 183/2006 Coll. on Spatial Planning and Building Rules (Building Act).
* Generally, activities that might endanger gas equipment, its reliability and operating safety are prohibited within the protective zone. (Section 68, Para. 3 of Act no. 458/2000 Coll.)

Annex 11 Minimum distance for planting of trees along roads

The following information is derived from ČSN 73 6101 Design of highways and motorways. The standard applies to design of highways, motorways, publicly accessible utility roads in open country, including relocations and renovations connected with reconstruction of earth embankments. It does not apply to field tracks.

Longest critical distance from a solid obstacle without a crash barrier:

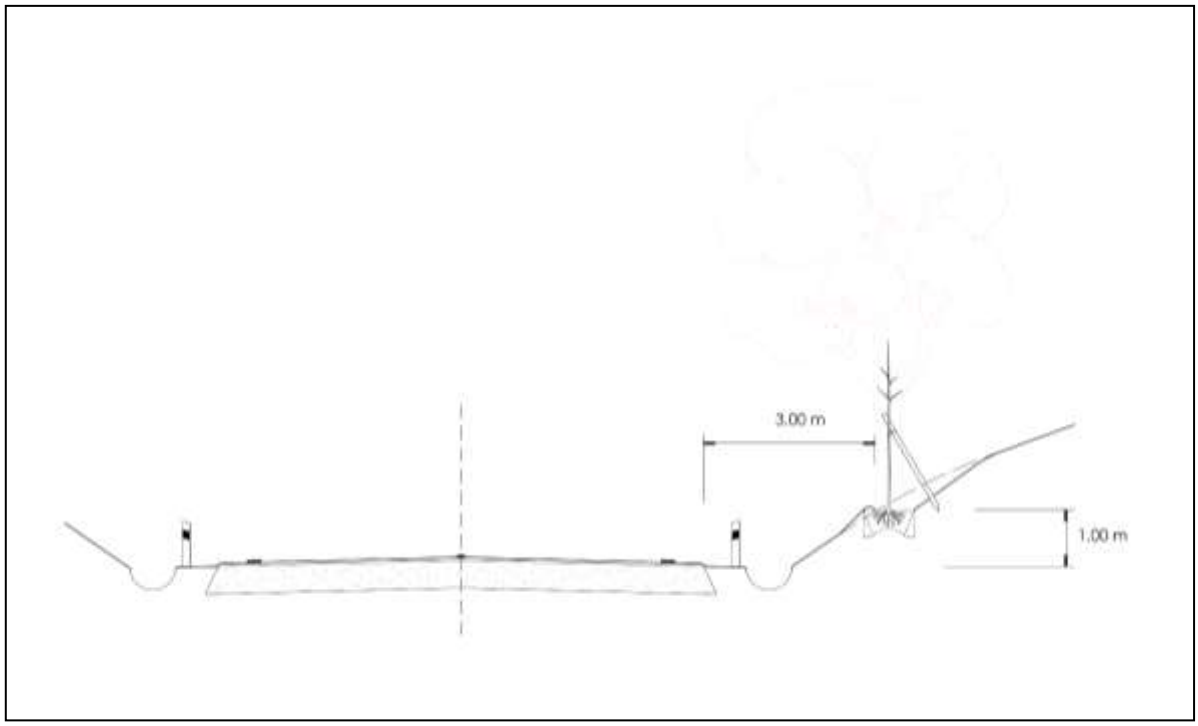


Planting can be done without problems beyond this distance.

Examples of schematic illustration without a crash barrier:

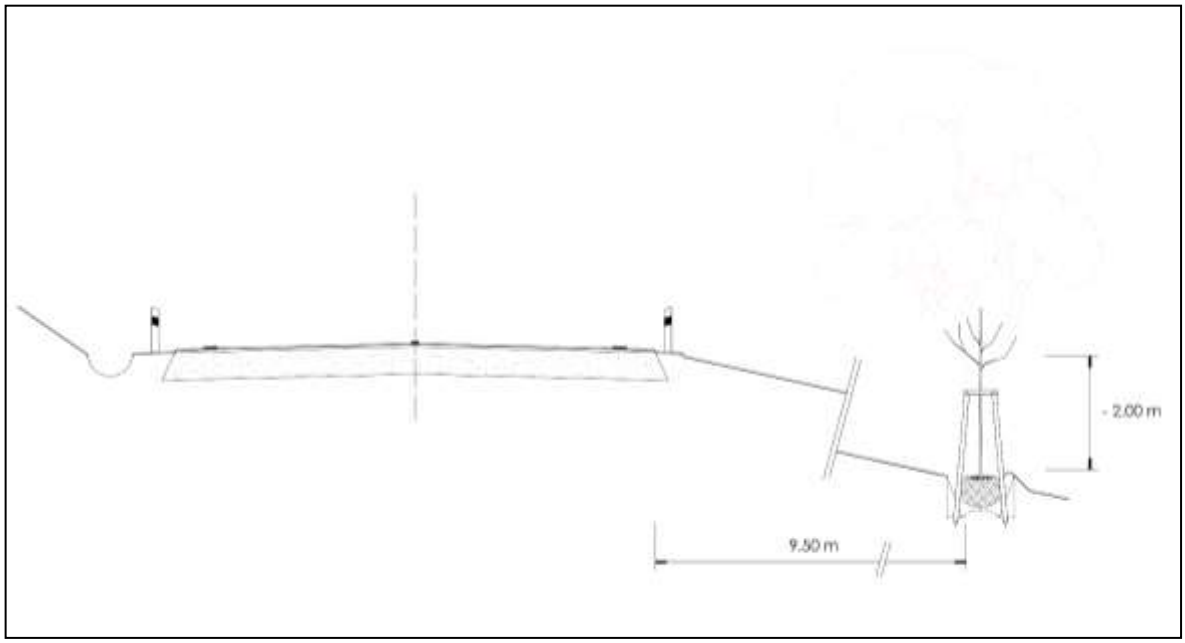
Road in a cut:

Planting of the tree according to the chart is possible if the trunk of a grown-up individual at a height of 1 mm above the carriageway is at least 3 m from the edge of the hard shoulder.



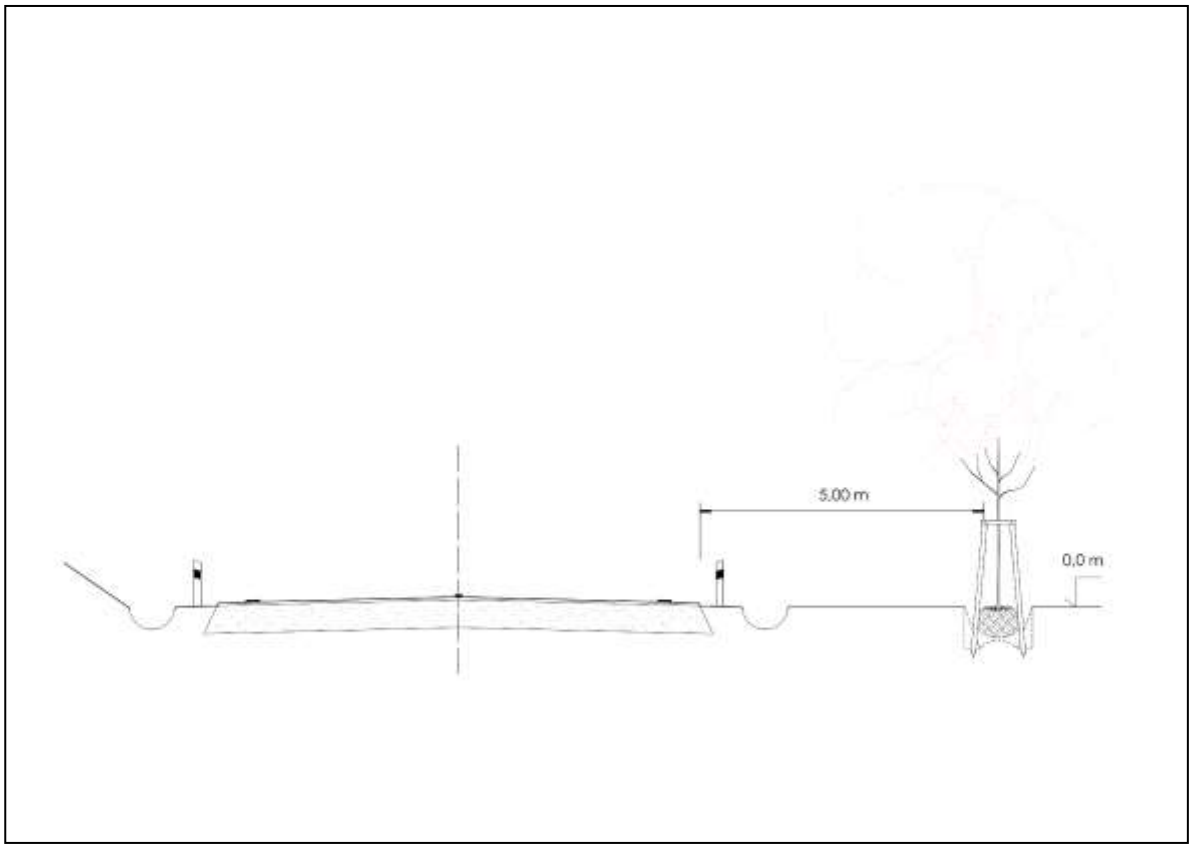
Road on an embankment:

Planting of the tree according to the chart is possible if the trunk of a grown-up individual at a height of -2 m below the carriageway is at least 9.5 m from the edge of the hard shoulder.



Trees at the profile grade line level of the carriageway edge:

Planting of the tree according to the chart is possible if the trunk of a grown-up individual at the profile grade line level of the carriageway is at least 5 m from the edge of the hard shoulder.



Annex 12 List of regulations defining the location of crash barriers

Czech National Standards (ČSN)

ČSN 73 6101	Design of highways and motorways
ČSN 73 7001	EN 1317-1 Road interception systems, Part 1: Terminology
ČSN 73 7001	EN 1317-2 Road interception systems, Part 2: Crash barriers

Technical requirements (TP)

TP 114	Crash barriers on roads
TP 128	NH4 steel crash barrier, spatial layout
TP 166	FRACASSO steel crash barrier
TP 167	NH4 steel crash barrier
TP 168	VOEST – ALPINE steel crash barrier
TP 185	ZSSK/H2 steel crash barrier
TP 190	ZSODS1/H2 steel crash barrier
TP 191	MS4/H2 steel crash barrier
TP 196	Vario Guard steel crash barrier
TP 203	Steel crash barriers (gutter type)
TP 206	MSK 2007 embedded concrete crash barrier
TP 223	SSŽ S97 concrete crash barrier
TP 227	ZSSAM/H2 steel crash barrier
TP 228	DELTA BLOC concrete crash barrier
TP 230	ZSH 2 steel crash barrier

Annex 13 Approximate quantity of water dose per watering

The extent of actual watering is governed by 5.3.5. Generally speaking, 1 mm of watering dose (which is 1 L of water per m^2) moistens 10 mm of soil substrate in blanket watering. In point watering, which is the most frequent method in tree management, consider an increased dose for the same depth of moistening.

Tree type	Watering dose
Maiden whip 60-80 cm	10 l
Maiden whip 80-125 cm	15 l
Maiden whip 125-150 cm	20 l
Maiden whip 150-200 cm	30 l
Tall crown OK 8-10 cm	30 l
Tall crown OK 10-12 cm	45 l
Tall crown OK 12-14 cm	60 l
Tall crown OK 14-16 cm	80 l
Tall crown OK 16-18 cm	100 l
Tall crown OK 18-20 cm	130 l
Tall crown OK 20-25 cm	150 l
Tall crown OK 25-30 cm	200 l

Annex 14 Illustrations

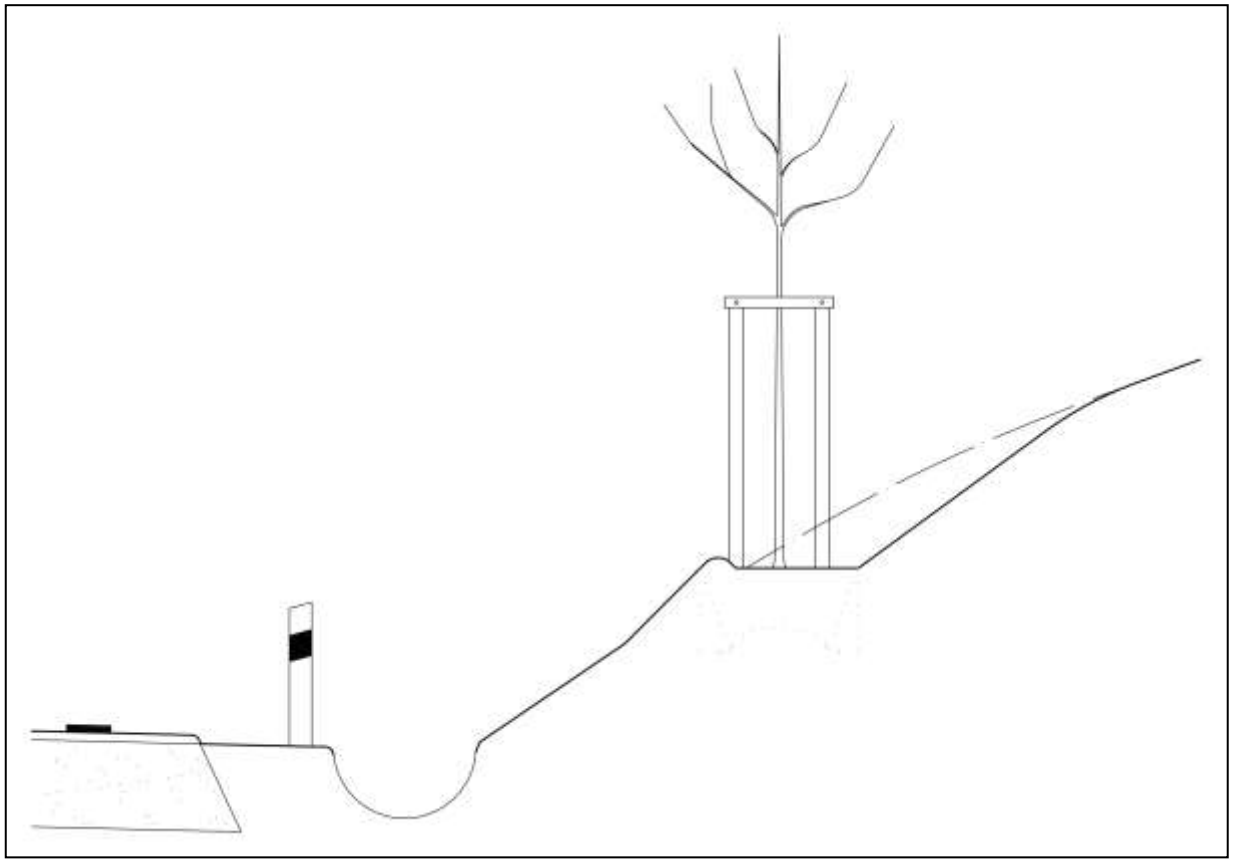


Fig. 1: Planting on a slope (4.6.2).

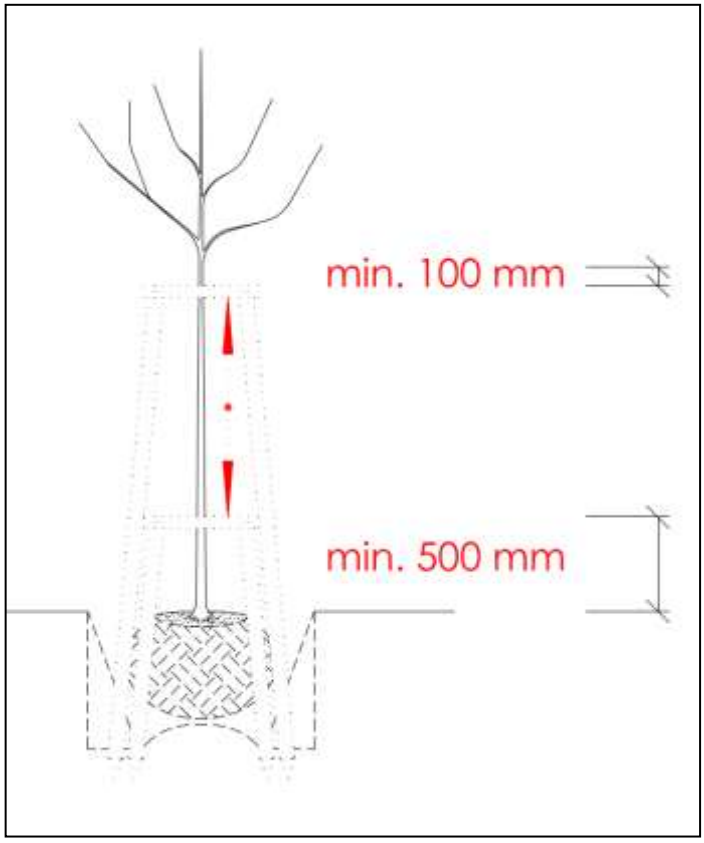


Fig. 2: Tree planting and anchoring dimensions (4.8.8).

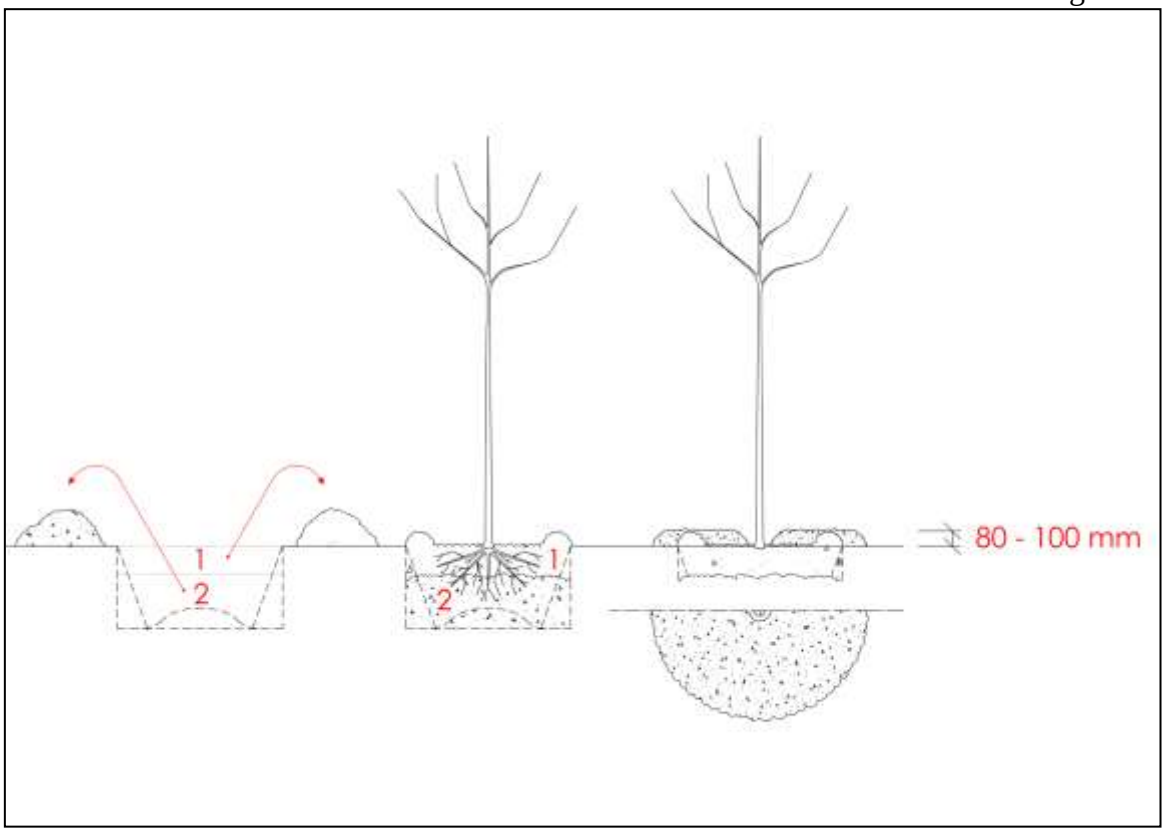


Fig. 3: Tree planting procedure (4.4.5).

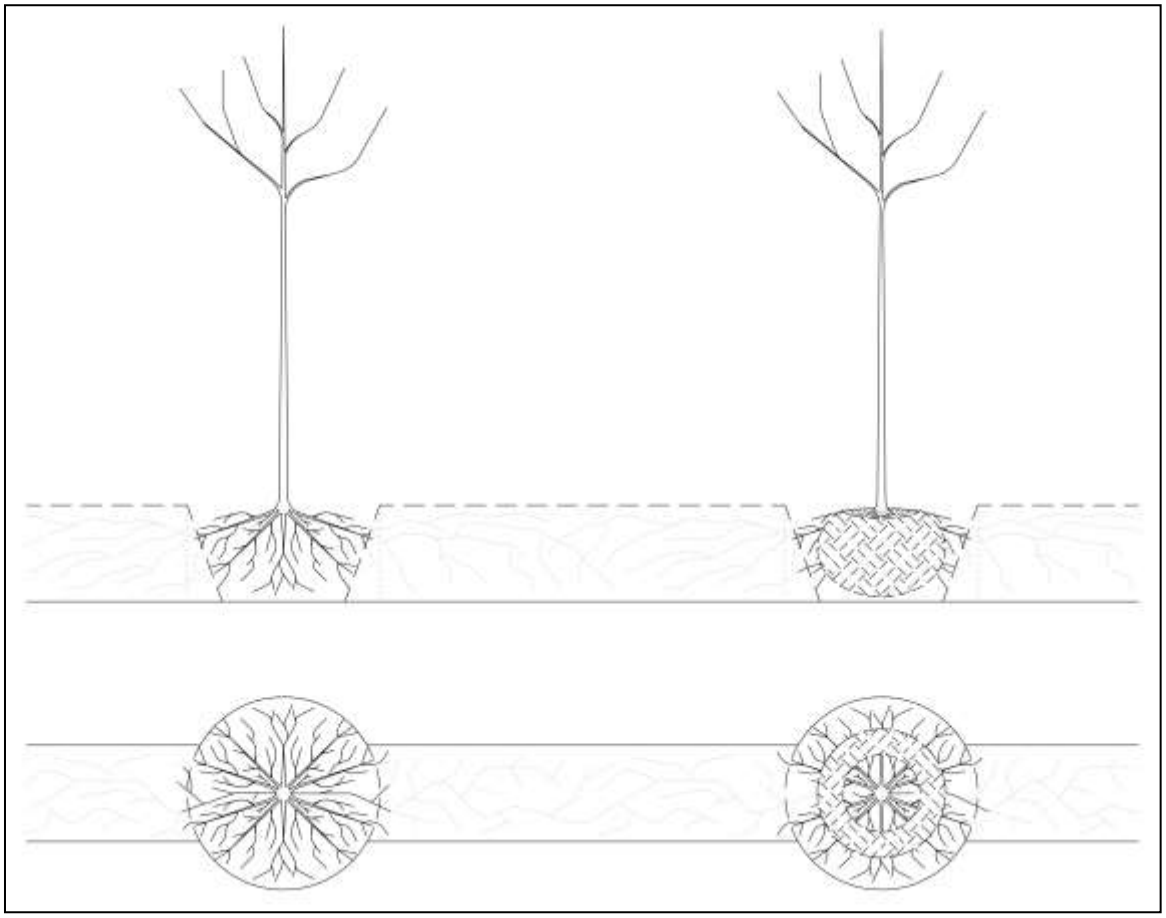


Fig. 4: Increasing rootable area with connecting trench (2.2.11).

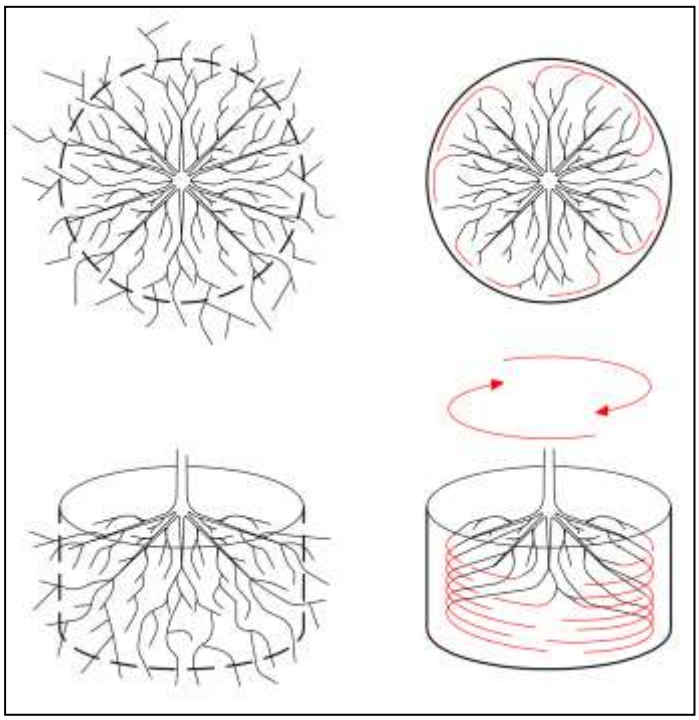


Fig. 5: Formation of curving roots (4.2.4).

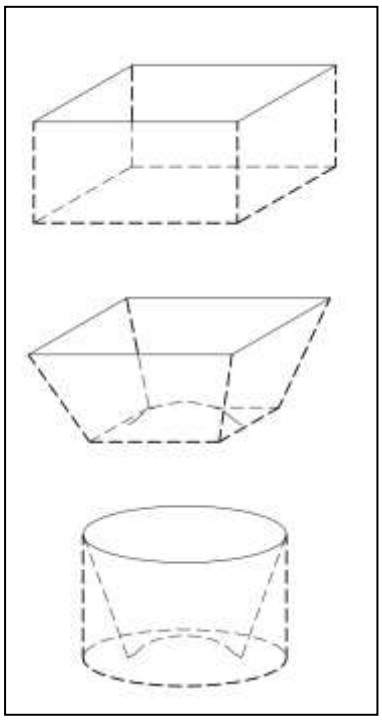


Fig. 6: Model types of planting pit shapes – basic (4.4.2).

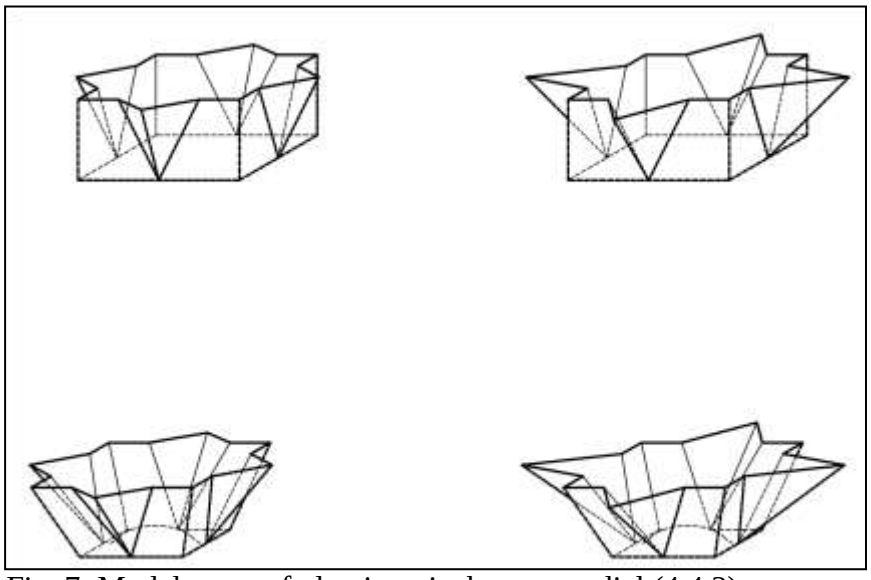


Fig. 7: Model types of planting pit shapes – radial (4.4.2).

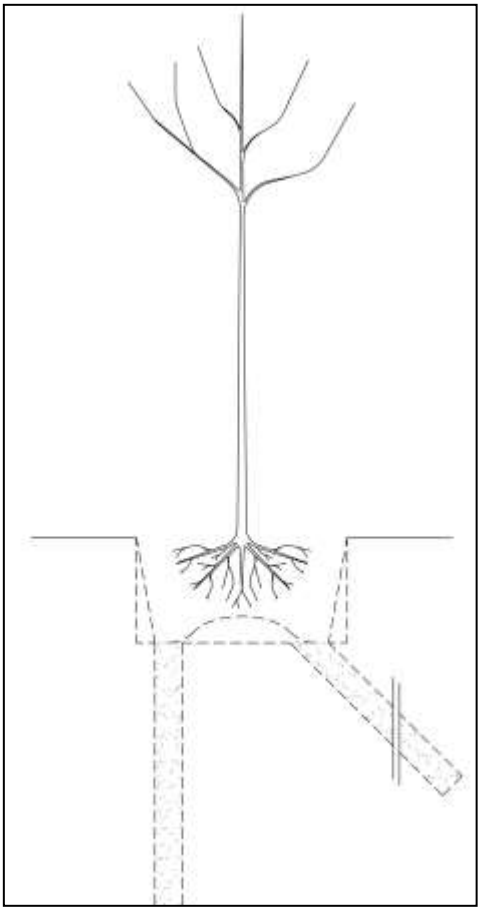


Fig. 8: Use of drains for impermeable soil horizon (4.4.8).

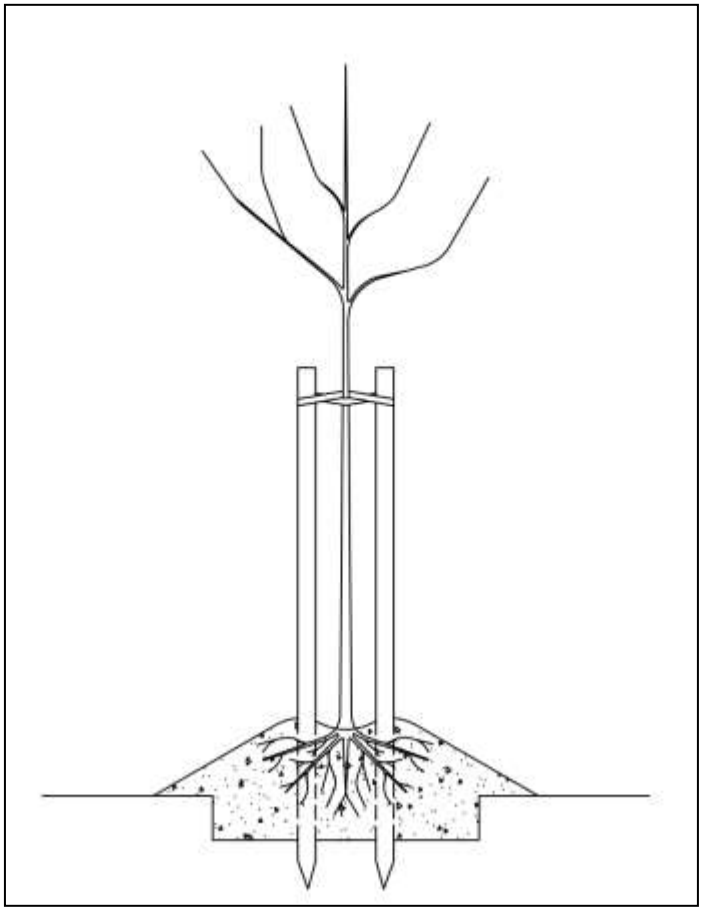


Fig. 9: Planting above ground level for higher water table (4.4.8).

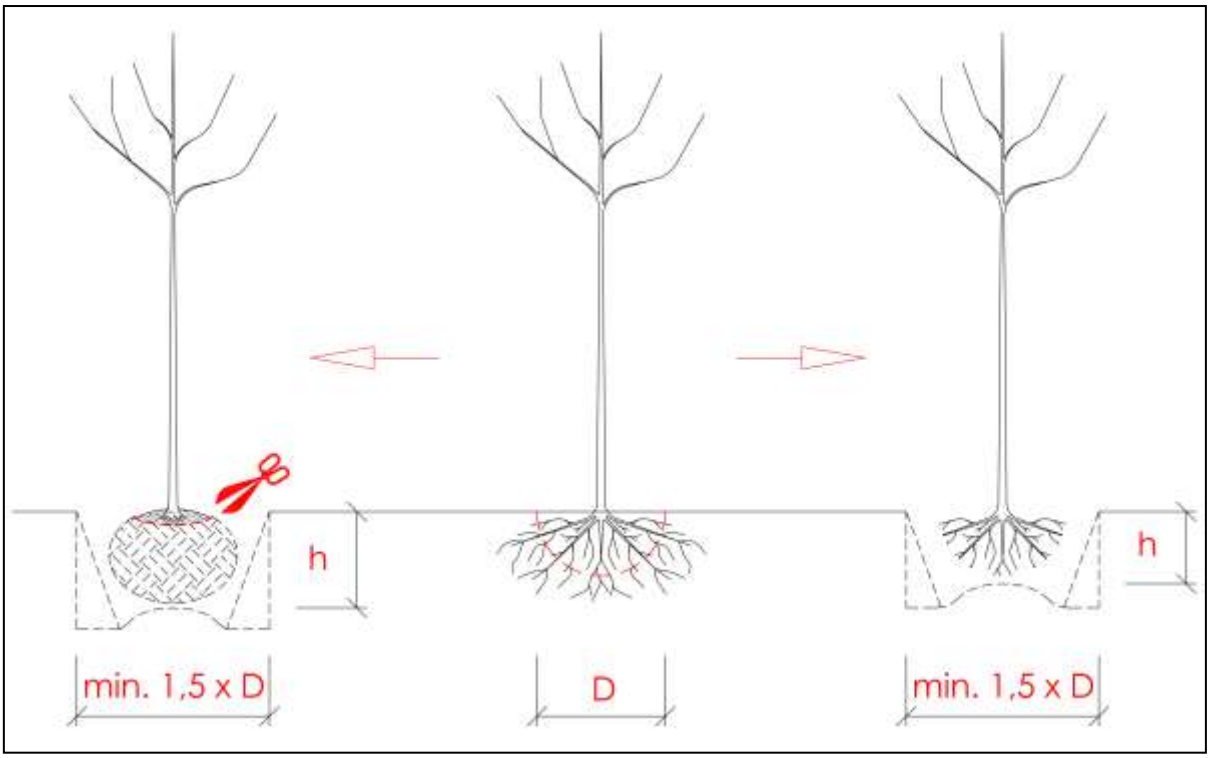


Fig. 10: Root adjustment during planting (4.6.5).

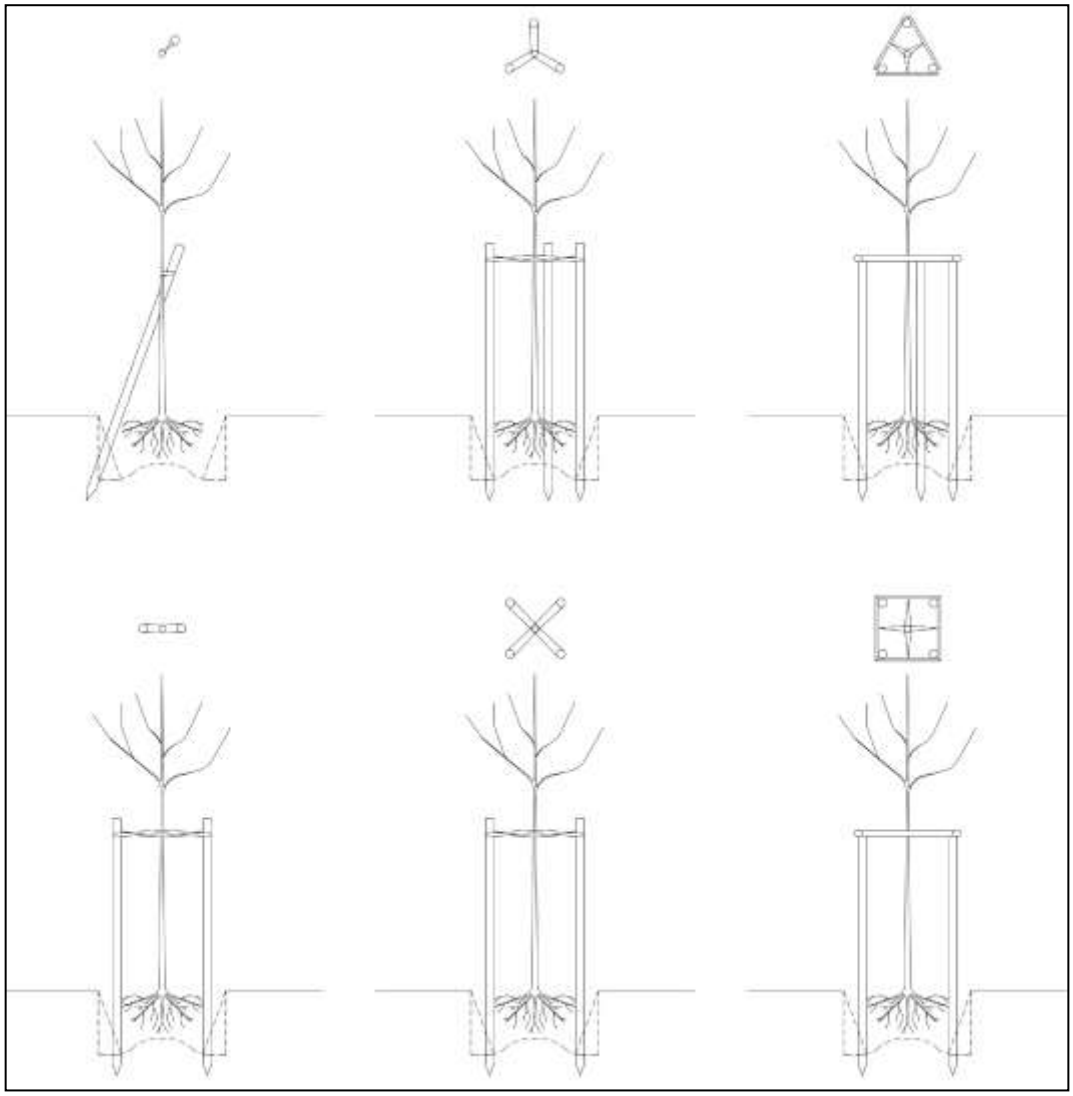


Fig. 11: Types of aboveground anchoring (4.8.2).

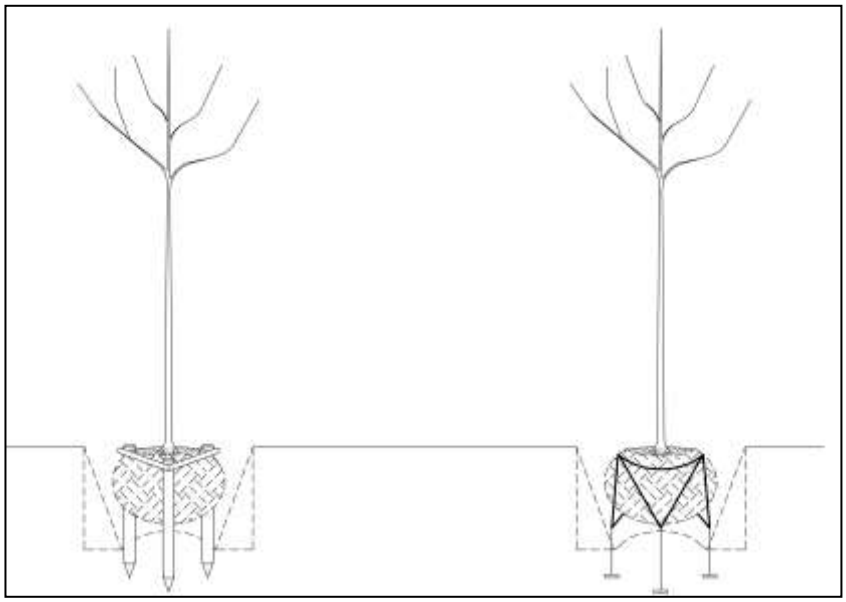


Fig. 12: Types of underground anchoring (4.8.10).

Annex 15 List of Nature and Landscape Management Standards (Arborist Standards) developed

00 General

00 001 Terminology

01 Inspection, assessment, planning

01 001 Assessment of tree condition
01 002 Protection of woody plants during development activities
01 003 Conflict between vegetation and structures
01 004 Biotope protection

02 Work procedures

02 001 Planting of trees
02 002 Pruning of trees
02 003 Planting and pruning of shrubs
02 004 Safety bonds and supports
02 005 Cutting of trees
02 006 Protection of trees against lightning strike
02 007 Modification of site conditions for trees and shrubs
02 008 Juvenile stand pruning
02 009 Special treatment of trees
02 010 Auxiliary vegetation along roads

03 Occupational health and safety

03 001 Area lockout during arborist operations
03 002 Protective equipment for tree climbing
03 003 Work procedures for tree climbing
03 004 Work with one-person chainsaws
03 005 Work with hydraulic platforms
03 006 Work with cranes

Faculty of Forestry and Wood Technology
Zemědělská 3
613 00 Brno

Kaplanova 1931/1
148 00 Praha 11

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