TREE PRUNING

European Tree Pruning Standard

2nd edition

European Arboricultural Standards

European Arboricultural Standards

EUROPEAN ARBORICULTURAL STANDARDS

Tree Pruning Standard

2024

BG: Оформяне на дървета
CS: Řez stromů
DA: Træbeskæring
DE: Baumschnitt
EL: Κλάδεμα δένδρων
EN: Tree Pruning
ES: Poda de árboles
ET: Puude lõikus
FI: Puiden leikkaaminen
FR: Taille d'arbre
GA: Crann ag bearradh
HR: Orezivanje stabala
HU: Fa metszése
IT: Potatura degli alberi
LT: Medžių genėjimas
LV: Koku kopšana
MT: Żabra tas-siġar
NL: Snoeien van bomen
PL: Cięcie drzew
PT: Poda de árvores
RO: Tăierea copacilor
SK: Rez stromov
SL: Obrezovanje dreves
SV: Trädbeskärning

Languages according to ISO 639-1 Code

Translations into other languages can be found on the project web page.

We are very grateful for all comments and support from national arboricultural representatives and individual arborists across Europe, who responded to the call for cooperation on the text of this standard.

This standard is intended to define the technical procedures used for pruning amenity trees.

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EAS 01:2024 (EN) – European Tree Pruning Standard.

If you want to translate text of the standard to other languages, please contact the project leader on eas@eac-arboriculture.com

Table of Contents:

1. Purpose and content of the standard

1.1 Purpose

1.1.1 This standard was published by the working group of the TeST project (Technical Standards in Tree Work) in cooperation with the EAC (European Arboricultural Council).

1.1.2 The TeST project was supported by the ERASMUS+ program. The European Commissions support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1.1.3 Within the text of the standard the following interpretations are used:

- where the standard says “can”, this refers to possible options,
- where the standard says “should”, this refers to a recommendation,
- where the standard says “must”, this refers to mandatory activities.

1.1.4 The purpose of the standard is to present the common techniques, procedures and requirements related to tree pruning with the aims of managing public safety and preserving the integrity of trees. The standard presents common fundamental practices used across European countries.

1.1.5 The standard applies to trees growing outside forests, in development stages from young to veteran and also includes mutilated or mismanaged trees.

1.1.6 The standard does NOT apply to pruning in the following contexts:

- forest management,
- fruit trees intended for fruit production.

1.1.7 In general, tree pruning is not recommended to resolve trivial perceived problems, such as those in the following non-exhaustive list, as any intervention can destroy ecosystem services delivered by the tree and may often lead to unstable trees and unnecessary follow-up work:

- shading of installed solar panels,
- (alleged) interference with TV or mobile signal reception,
- leaf and fruit fall,
- allergic nuisance etc.

1.1.8 The standard provides safety criteria for arborists and other workers engaged in arboricultural operations. This standard serves as a reference for safety requirements for those engaged in tree pruning or maintenance.

1.1.9 Each person must take responsibility for his or her own safety on the job site and comply with the appropriate national, federal or state professional safety and health standards, including all rules and regulations that are applicable to his/her actions. Each person must also read and follow the manufacturer‘s instructions for the tools, equipment and machinery that he/she uses.

1.2 Tree pruning objectives

1.2.1 Outside the forest, trees are pruned for a variety of reasons. The most important are as follows:

- safety of people and traffic,
- clearance for traffic, buildings, construction work etc.,
- managing trees to get the greatest benefits at a responsibly low cost,
- for identified objectives with specific maintenance aims,
- prevention and management of pests/diseases.

1.2.2 Proper tree care is necessary, because people need trees in urban areas for many wellbeing and health reasons. For example, to:

- improve the living environment in urban areas,
- combat the city heat island effect,
- filter dust and particulate pollution,
- (perceived/subjective) sound reduction,
- preserve and manage (old) green structures,
- design green public areas/spaces where people can rest and play.

1.2.3 It is important to acknowledge that trees generally do not need pruning. Most pruning is done for objectives related to human needs, as defined in the following paragraph.

1.2.4 The most common objectives of pruning trees are as follows:

- adapting the individual tree's structure to the limitations imposed by the space in which it grows (e.g., creating clearance from roads or buildings),
- increasing the aesthetic value of the specimen and its surroundings,
- retaining the biological value of trees and their specific features (microhabitats),
- avoiding the shedding of branches that could cause damage to people and property,
- limiting the risk of failure of the whole tree or its parts,
- minimising conflict between trees or parts of trees and adjacent structures (e.g. power lines, buildings etc.),
- removing parts of trees affected by pests or diseases.

All of these objectives are generally defined and combined in one „desired image" for the tree.

1.2.5 Tree pruning results in injuries that can increase wood colonisation by fungi and cause energy-consuming wound reactions.

1.2.6 Tree pruning should be limited to cases where the positive effect of the work carried out clearly exceeds the negative potential from the resulting injuries. Otherwise, it is preferable to continue with the status quo, and not to intervene.

1.3 Biosecurity

1.3.1 People professionally involved in pruning trees are inherently at high risk of transmitting pests and diseases between trees and worksites and thus should apply appropriate biosecurity procedures to limit this risk.

1.3.2 To reduce the risk of transmitting pests and diseases, cleaning tools and other equipment must be part of daily maintenance.

1.3.3 When trees with contagious pests and diseases are being pruned, hand saws are the tool of choice for most pruning operations because they can easily be cleaned.

1.3.4 All equipment should be cleaned and disinfected according to the manufacturers guidelines.

1.3.5 When trees with a high probability of being infected with contagious pests and diseases are being worked on, increased biosecurity standards must be applied, such as cleaning and disinfecting[1] cutting tools between trees. National legislation applies.

[1] Tool disinfection alone isn't fully effective with current methods in arboriculture.

2. Normative references

2.0 This standard is complementary to other EU standards and national/regional regulations.

2.1 Qualification

2.1.1 Tree pruning and related arboricultural operations are professional activities that can only be performed by a suitably trained and experienced worker or by a trainee under supervision.

2.1.2 Generally accepted proof of an arborist's qualifications is established by international or national certifications. Within the EU, the following certification schemes are recognised for practising arborists:

- EAC European Tree Worker (ETW)/ European Tree Technician (ETT),
- ISA Certified Arborist,
- EAC VETcert Veteran Tree Specialist.

2.1.3 Meeting the standards of professional qualification includes continuing professional development/lifelong learning.

2.1.4 National qualification references may be recognised locally. These are listed in the national appendices to this standard.

2.2 General safety requirements

2.2.1 Tools and equipment must conform to the requirements of CE and EN standards and certification.

2.2.2 A job briefing and site-specific risk assessment must be communicated to all workers by the qualified arborist/supervisor on site.

2.2.3 Traffic and pedestrian control around the job site must be established prior to the start of any arboricultural operations.

2.2.4 Arborists and other workers working on or near traffic zones and operating temporary traffic control zones must be trained in temporary traffic control procedures, device usage and placement, and how to work safely according to national health, safety and traffic regulations.

2.2.5 Arborists and other workers exposed to risk of traffic must wear high-visibility safety clothing which meets the requirements of national regulations.

2.2.6 Arborists and other workers who use any equipment, tools and machinery must be familiar with safe work practices and appropriate personal protective equipment (PPE) usage, according to manufacturers' instructions for these tools, machinery and equipment.

2.3 Emergency action planning

2.3.1 Arborists and other workers must fulfil the following conditions:

- employees must comply with national (local) regulations and guidance regarding safe working procedures for tree work at height,
- on the work location certified/ trained employees in first aid and rescue climbing must be present.

2.3.1.1 **Management** needs to provide the following information:

- project location,
- contact person/client (ordering party) for the project with telephone number,
- project description/type of work/ risks/rules,
- name and telephone number of immediate supervisors,

- 2 employees minimum at the work site or more, depending on the project,
- names of the employees, their certification(s) and mobile numbers,
- safety measures to be used for the project,
- standard personal protective equipment,
- if necessary special personal protective equipment or special treatments,
- up to date first aid equipment,
- telephone number of the emergency services.

2.3.1.2 **Employees/Operators** need to fulfil the following demands:

- must not be under the influence of psychotropic substances (alcohol, drugs, medication, etc.),
- must be familiar with the hazards and possible risks,
- must be familiar with safety rules and procedures,
- must know the address(es) of the nearest hospital/hospitals or emergency centres and, where applicable, identify a landing site for air ambulance,
- establish an escape or emergency route from the work location to the public road,
- must know the address(es) of the nearest hospital/hospitals or emergency centres and, where applicable, identify a landing site for air ambulance,
- must know the location of the up to date first aid kit at the work location,
- must be trained to identify common poisonous plants, stinging and biting insects and other dangerous organisms in the area where the tree work is to be carried out,
- must be familiar with preventive measures to avoid injury and damage.

3. Pruning techniques

3.1 Introduction

3.1.1 The aim is to achieve wound occlusion as soon as possible, and pruning should not negatively influence life expectancy. Therefore, optimum conditions for pruning include good vitality, overall good health (lack of significant damage that already weakens the tree's physiology), lack of significant pests and diseases, and suitable environmental conditions (no drought, frost etc.).

3.1.2 Apart from the "human centered" pruning objectives, conditions that are considered as not preferable for removal of living branches (pruning) include:

- poor vitality,
- poor growing conditions.

In any of these circumstances, if possible, pruning should be postponed until the tree recovers or the environmental conditions are suitable. If pruning is conducted in unfit conditions, the reasons for the work and the possible consequences must be communicated to the tree owner.

3.1.3 All work performed on trees and in their surroundings should take into account the possible presence of accompanying organisms, in particular protected species.[2] Their occurrence will be very likely on veteran trees and other trees showing increased natural value (due to the presence of hollows, decay, etc.).

3.1.4 Due diligence must be exercised in order to prevent damage and destruction of the habitats of valuable and protected species, both during access to the tree (e.g. damage to protected lichens while climbing, knocking down a bird's nests, removing fungal fruit bodies etc.) and the work on the tree itself (e.g. removing hollows inhabited by birds, bats etc.).

3.1.5 Before starting the works, it is necessary to inspect the whole tree for the presence of potential habitats for protected species.If

3.1.6 protected species are present or suspected, it may be necessary to contact the relevant authority related to the protection of the plants, animals or fungi in question and if necessary hold the relevant permit to carry out the work.
Even after receipt of such a permit, due diligence (so as not to damage / destroy other habitats) must be exercised, and the work should be carried out under appropriate environmental supervision.

3.1.7 It should be remembered that scaring and disturbing protected animal species is also prohibited, so all work on the tree must take this requirement into account.

3.1.8 In such instances (3.1.4. to 3.1.7), the following should be done:

- withdraw from work,
- inform the ordering party of the presence of protected species in the tree,
- inform the ordering party that the works may be resumed after the relevant permit is received.

3.1.9 Pruning of trees should preferably be carried out using hand tools (hand saws or pruning shears/secateurs). Chainsaws can be used to prune branches with diameter over 5 cm.

3.1.10 All tools must be sharp, clean and suited to the task being performed.

[2] Check EU, national and regional regulations for current lists of protected species of fauna, flora and fungi.

3.2 General rules

3.2.1 The **size of pruning** wounds must be minimised by removing the smallest proportion of the crown necessary to meet the objectives of the particular pruning intervention. It is often preferable to perform multiple small cuts further away from the trunk than a small number of large cuts lower in the crown or directly on the stem, except when pruning in the temporary crown of young trees (1/A).

3.2.2 In order to keep pruning interventions to the minimum, pruning must start as early as possible in the tree's life (in the case of predictable issues) and be repeated regularly at suitable time intervals.

3.2.3 When pruning trees, the influence of the altered crown shape on aerodynamics must be considered, especially the changed biomechanical impact on the pruned tree and the surrounding trees.

3.2.4 It is advised that wound sizes should not exceed a maximum diameter of:

- 5 cm in tree species with weak compartmentalisation,
- 10 cm in tree species with effective compartmentalisation. (see Appendix 1)

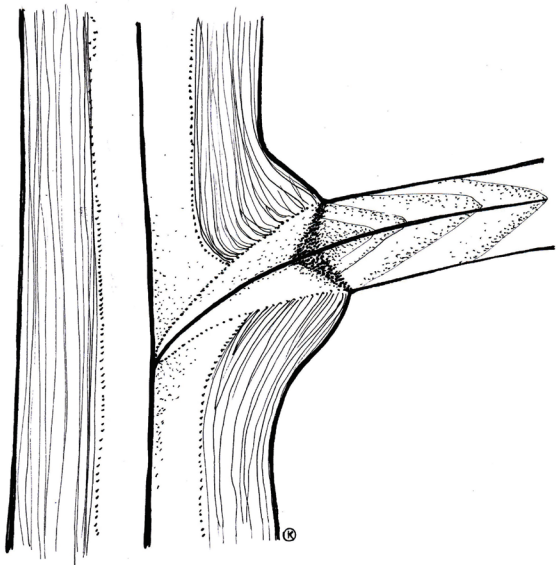
Exceptions can apply in the case of:

- pruning of dead branches,
- branch removal for safety reasons.

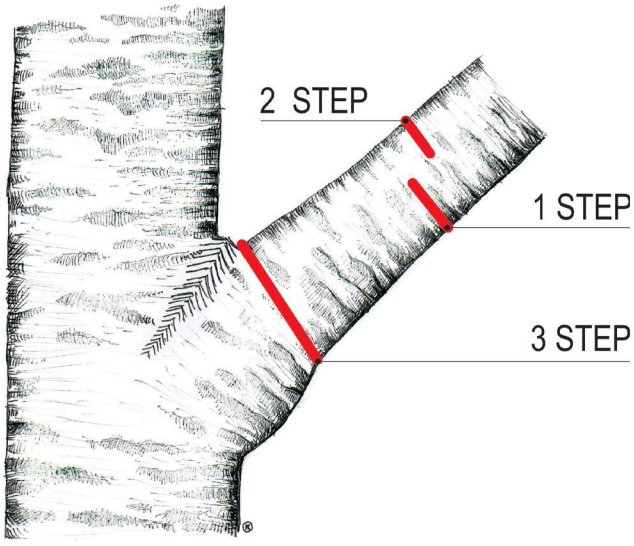
3.2.5 It is advised that the diameter of a side branch to be removed does not exceed ⅓ of the diameter of the parent branch (trunk).

3.2.6 The following principles are to be followed when pruning amenity trees:

3.2.6.1 To prevent ripping of the tissues below the pruning point, it is advisable to perform a **step cut** (three-stage-cut) when removing larger branches. In general, the first cut is made on the underside of the branch (approximately ¼ to ⅓ of the branch diameter, depending of the tree species) not less than 20 cm from the branch collar or more if safe removal of the stub so requires (e.g., if a larger diameter stub needs to be manhandled/lowered). The second cut is made on the top side of the branch slightly away from the first cut, until the branch is dropped or broken off by hand. The remaining stub is removed by target pruning or another appropriate method.
The positions of the cuts can differ depending on the surroundings, tree species, branch size, growth and breaking direction.



PICTURE 1: Cross section through the branch connection of a dead branch with first wound reactions in the wood.



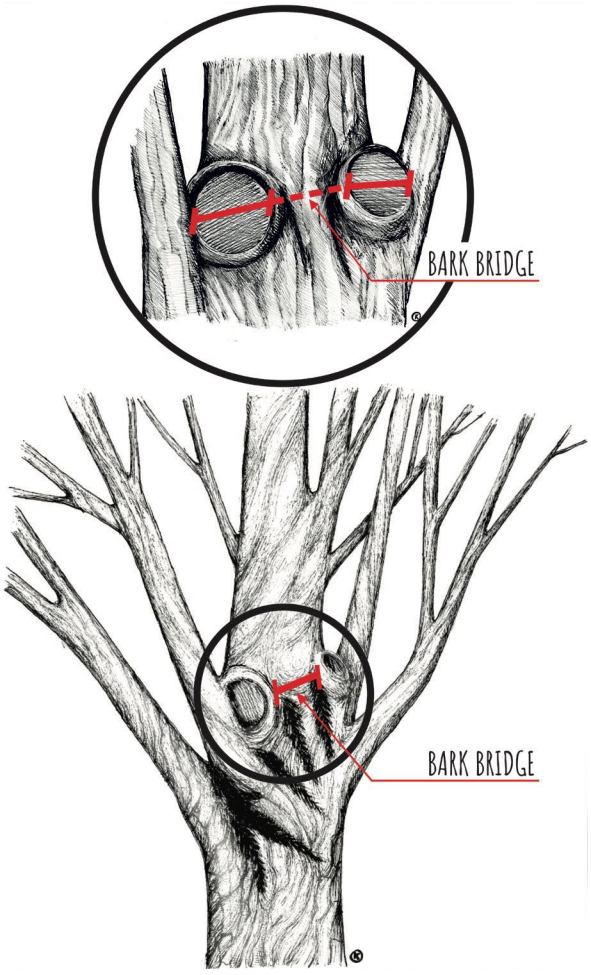
PICTURE 2: Step cut.

3.2.6.2 If it is necessary to remove multiple branches in one area on the trunk ("stacked branches" growing in pairs or rings), enough space between the cuts should be left in order to avoid a significant bottleneck in the tree's vascular system and overlapping reaction zones leading to dysfunction in the parent stem. It is advisable to leave an intact "**bark bridge**" between multiple wounds in the same area, at least as large as the bigger of the two wounds. If this cannot be achieved, the cuts should be spread over time, over a number of years.

3.2.7 **Dead branches** are a natural part of a tree crown and should not be removed unless necessary. They are important for biodiversity support. In some species, dead branches may have a role in damping the movements of living branches. On the other hand, dead branches are often partially decayed and can easily break and fall (note that some dead branches do not fall off readily, e.g. dead limbs without bark in *Quercus* and *Castanea*, and dead limbs in some *Pinus* species).

3.2.8 Deadwood and stubs hinder complete closure of the wound by woundwood (callus). This can increase fungi colonisation and decay development in the area of branch attachment and in the stem.

3.2.9 If dead branches must be removed, leaving the base of the dead branches (stubs) can give a more natural appearance to the tree (especially if they are removed by breaking the branch) and support biodiversity. The pros and cons of this approach must be considered for each individual tree.



PICTURE 3 : Bark bridge.

3.2.10 Deadwood management during structural pruning significantly differs depending on the tree's status and the type of pruning.

TABLE 1: General rules of approach to pruning deadwood.[3]

Formative pruning	Dead and dying branches in the temporary crown should be removed regularly and completely. If permanent crown is present, stable dead stubs can be left in justified cases.
Crown maintenance	Dead and dying branches in the permanent crown should be retained (completely or reduced) for biodiversity reasons[4] as long as this does not compromise an acceptable level of risk. If deadwood is to be removed, this should only apply to branches likely to cause damage or injury, e.g. with a diameter exceeding 5 cm and a length over 1 m.[5] Dead branches can also be reduced to stubs or broken off. Stable dead stubs can be left.
Veteran trees (ancient, senescent, over-mature)	Deadwood should be preserved as much as possible in order to protect the associated habitat and the decay processes under natural conditions (in the crown and on the ground), while keeping risk at an acceptable level.

3 Specific details about deadwood management can be found in Deadwood Fact Sheet (see project page).
4 Differences in national standards apply.
5 Saprotrophic fungi decomposing deadwood are not to be considered pathogens. In specific cases pathogens with a risk of disease transmission may be present and appropriate biosecurity measures must be taken.

3.2.11 The optimal **pruning season** is determined by the aims of minimising physiological stress and supporting natural wound reactions and/or regrowth of trees. Pruning should NOT be performed in the following periods:

- post-dormancy (spring) – period between bud breaking and full development of leaves,
- pre-dormancy (autumn) – period when leaves start to colour until they are shed or fully dysfunctional,
- during long periods of drought.

3.2.12 Tree species with intensive sap flow (see Appendix 2) are not to be pruned during dormant period.

3.2.13 The optimal pruning season also depends on the pruning operation.

TABLE 2: Optimal pruning seasons for major pruning operations.

Structural pruning	Pruning during the growing season is preferred.
Lateral crown reduction	
Upper crown reduction	Optimal season cannot be specified as this depends on local habits in relation to specific conditions (see national appendices).
Shaping	Pruning is generally done during the dormant period. Trimming can be done during the growing season.
Restorative pruning	Pruning during the growing season is preferred.
Always avoid pruning during long periods of drought.	

3.2.14 Recommendations for optimal pruning season may differ depending on tree species and climate (e.g. periods of drought or frost). Legislative restrictions may apply in some countries.

3.2.15 **The pruning interval** must be carefully considered, in addition to the assessment of the tree's physiological stress, in relation to the risk of affecting valuable micro-habitats or specific associated organisms that inhabit the tree and its surroundings (see 3.1.3 to 3.1.8).

3.2.16 General pruning intervals:

- young tree: regular pruning, small interventions (once in 2-3 years),
- semi-mature tree: interval becomes longer, tree is allowed to develop more freely,
- mature tree: intervene only when really necessary,
- veteran tree: intervene only when really necessary.

3.2.17 During any pruning operation, consider any impact on biodiversity. The timing, technique or amount of foliage removed may need to be adapted to maintain or improve biodiversity.

3.2.18 Tree pruning is usually not a one-off action and must be managed and repeated regularly, at intervals depending on the development stage of the tree and the type of intervention. Ideally all (future) pruning operations are defined in a long-term tree management plan.

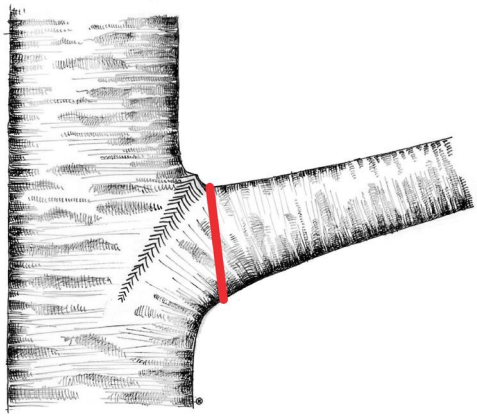
3.2.19 Wound dressing (synthetic substances or solutions) to overlay pruning wounds should not be applied. In general, the negative consequences outweigh and positive effects[6].
If wound treatments are to be used in special cases, they must not damage living tissues of the tree.

6 DUJESIEFKEN, D. (Ed.), 1995: Wundbehandlung an Bäumen. Contributions by H. Balder, L. Dimitri, D. Dujesiefken, P. Grimm-Wetzel, T. Kowol, W. Liese, T. Maag, K. Schröder, E. Schmitz-Felten, G. Seehann, H. Strohm, and S. Wiebe. Verlag B. Thalacker, Braunschweig, 151 pp.

3.3 Branch removal methods

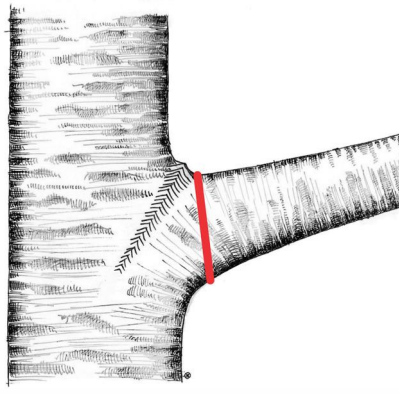
3.3.1 The main **branch removal methods** are described in the following paragraphs and their possible use is defined in „Main pruning operations“ (section 3.4.).

3.3.2 **Target pruning** is removal of a side (lateral) branch just beyond the branch collar (which belongs to stem tissues) without damaging the branch collar.
The main purpose of this technique is to remove a branch while minimising regrowth and the extent of dysfunction, and supporting natural processes of wound reaction.



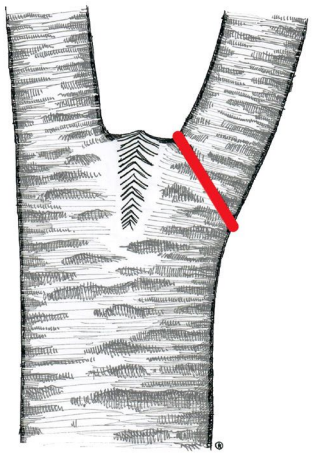
PICTURE 4 : Target pruning.

3.3.2.1 If a **branch collar is not clearly visible**, the cut must be positioned outside of the branch bark ridge without damaging it. The angle of the cut in comparison to a branch with a visible collar should be performed more parallel to the stem to avoid the formation of a dead stub at the lower margin of the wound. Flush cuts (removal of stem tissues) must be avoided in all cases.



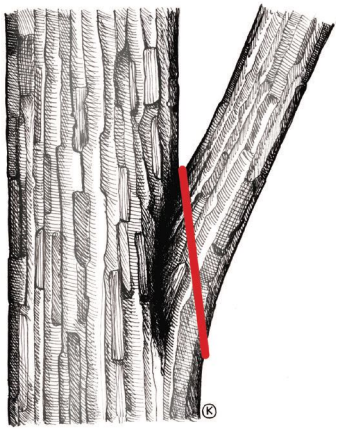
PICTURE 5: Pruning of branch with non-visible branch collar.

3.3.2.2 When removing a **co-dominant leader**, the cut must be positioned outside of the bark ridge without damaging it, as close as possible to the shoot that is left. The position of the bark ridge determines the cutting angle. If possible, it is better to suppress the co-dominant shoot by pruning back to a lateral.



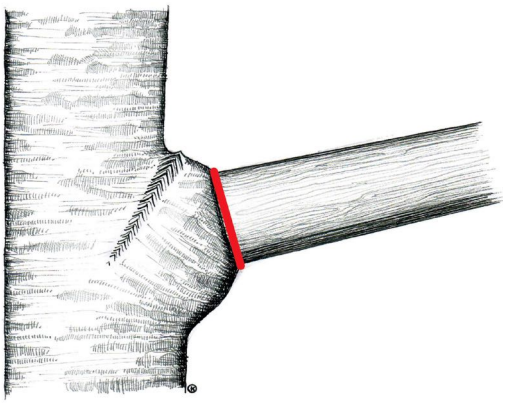
PICTURE 6 : Pruning of co-dominant leader.

3.3.2.3 **Included bark** is the condition whereby inner and outer bark forms between the branch and the trunk or between co-dominant shoots in forks with included bark. If included bark is present between branch and stem, a cut must be made as close as possible to the stem, without injuring stem tissue above the branch base.



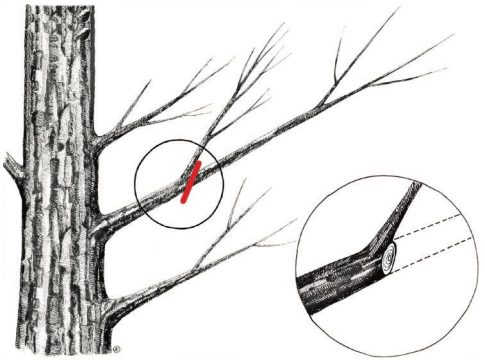
PICTURE 7: Pruning of branch with included bark.

3.3.2.4 At the base of **dead branches**, a swollen branch collar often forms naturally. The collar must not be damaged when removing these branches, even if this means cutting at a distance from the main stem. Dead branches can also be removed by breaking them, leaving a stable stub with a natural tear.



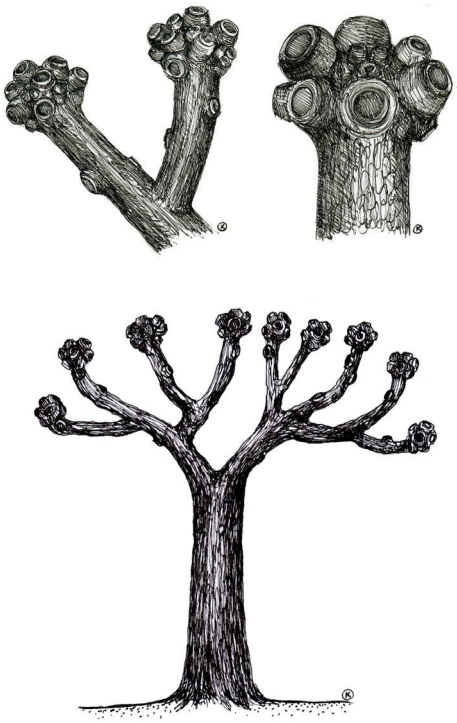
PICTURE 8: Pruning of dead branches.

3.3.3 **Pruning to a lateral** (head cut, reduction cut) is the removal of the main axis (leader) of the branch/limb, leaving a living side (lateral) branch to sustain the remaining branch. It is recommended to leave a vigorous lateral branch with a diameter of at least ⅓ the diameter of the pruning wound. The lateral branch should form a logical extension of the parent stem, so this branch removal technique should not lead to significant changes in the direction of the branch axis or to biomechanically unstable joints (e.g. "dog leg"). The angle of the cut is to be placed at a slant, outside of the bark ridge, in the area of the remaining lateral branch. Pruning to a lateral branch of insufficient diameter or to epicormic branches is considered to be stub cutting.



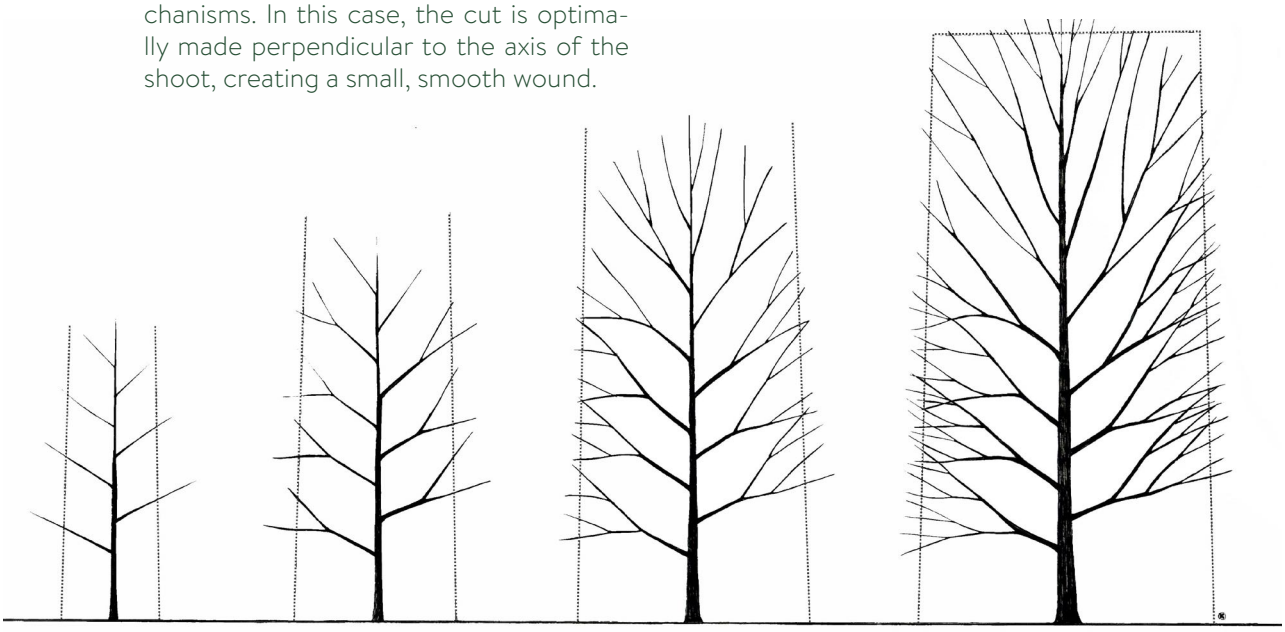
PICTURE 9: Pruning to a lateral.

3.3.4 **Knuckle cut** is a regular (repetitive) removal of epicormic shoots on very short stubs (usually about 1 cm in length) with retention of dormant buds in the branch base.



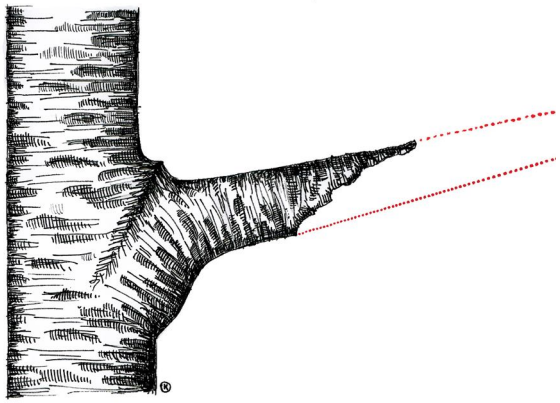
PICTURE 10: Knuckle cut.

3.3.5 **Trimming** is a branch removal method used in cases of pruning trees into formal shapes and pruning hedges, when annual shoots are removed or reduced using hedge shears, trimmers and similar mechanisms. In this case, the cut is optimally made perpendicular to the axis of the shoot, creating a small, smooth wound.



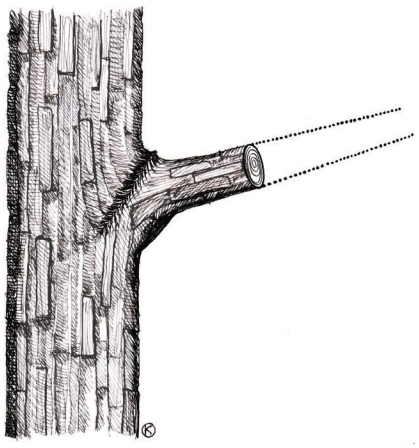
PICTURE 11: Trimming.

3.3.6 **Rip cut/controlled breakage** is a branch removal method in which a branch is broken off, often after a preliminary partial cut has been made on the upper side of the branch. The purpose is to create a tear that follows the natural breaking patterns as much as possible. With this branch removal method, the aim is to support biodiversity and mimic the aesthetics of natural breakage (natural shedding) of branches.



PICTURE 12: Rip cut.

3.3.7 **Stub cutting** (internodal cut) is the removal of a branch/limb leaving behind a stub, without leaving a lateral leader of sufficient size (⅓ of the diameter of the stem). When carrying out the cut, the branch tissues must not be torn. The cut is perpendicular to the axis of the branch.If small lateral branches or epicormic branches are present, these should be retained when making the final cut.



PICTURE 13: Stub cutting.

3.4 Main pruning operations

3.4.0 Before any pruning work is carried out, the following prerequisites must be completed:

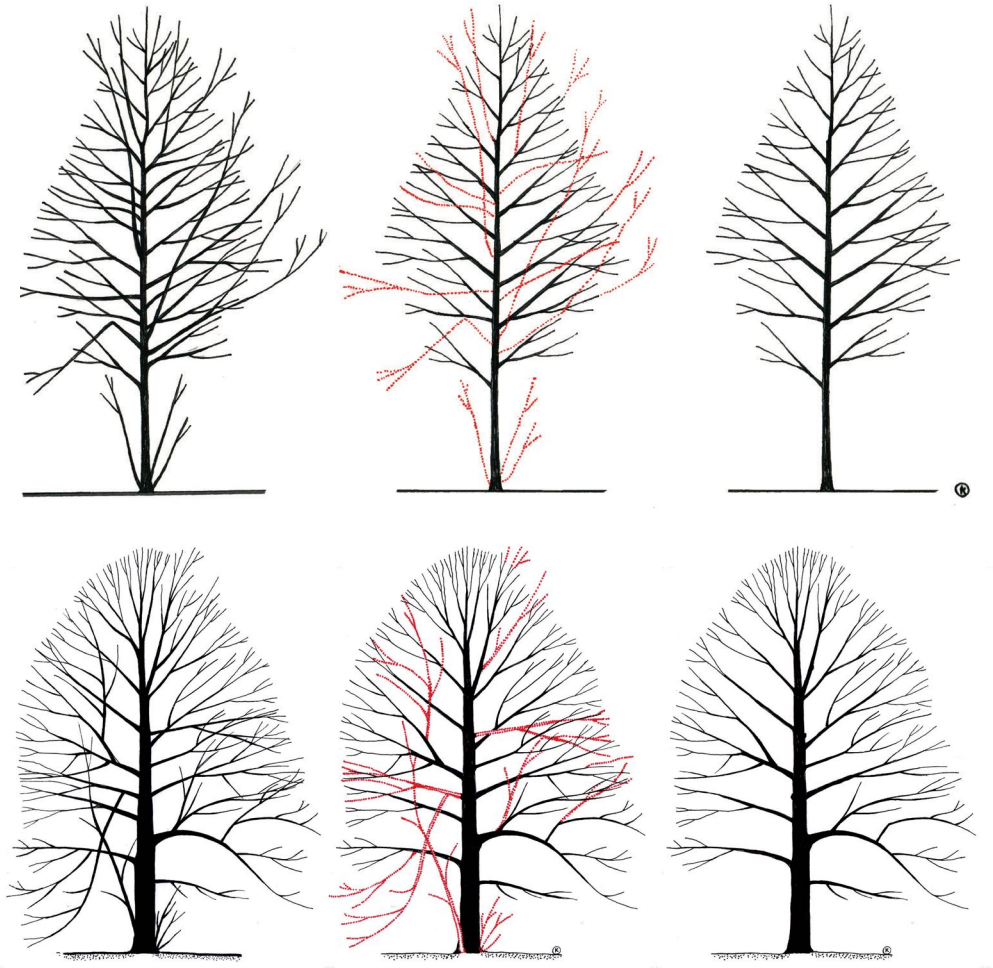
1. tree condition assessment is carried out,
2. clear objectives for pruning are defined (see 1.2),
3. the tree's ability to respond to the wounds caused by pruning is evaluated,
4. potential conflicts with biodiversity and biosecurity regulations are addressed (see 1.3. and 3.1)
5. Worksite inspection is carried out. (see EAS 04:2024 European Tree Assessment Standard)

3.4.1 Structural pruning

3.4.1.1 **Objectives:** Intervention in the crown structure and shape of the tree to establish and maintain its desired, stable structure (for example, by removal or reduction of branches with weak forks[7]). Change of tree height or substantial change of crown shape is not allowed.

3.4.1.2 Reasons for structural pruning may be:

- to establish a single dominant stem,
- to suppress of overgrown secondary shoots,
- to limit how much branches rub where they are not forming a natural brace,
- removal/reduction of unstable damaged or decayed branches,
- removal/reduction of branches colonised by pests or diseases,
- to establish good branch distribution,
- deadwood management.



PICTURE 14: Structural pruning of young and mature trees.

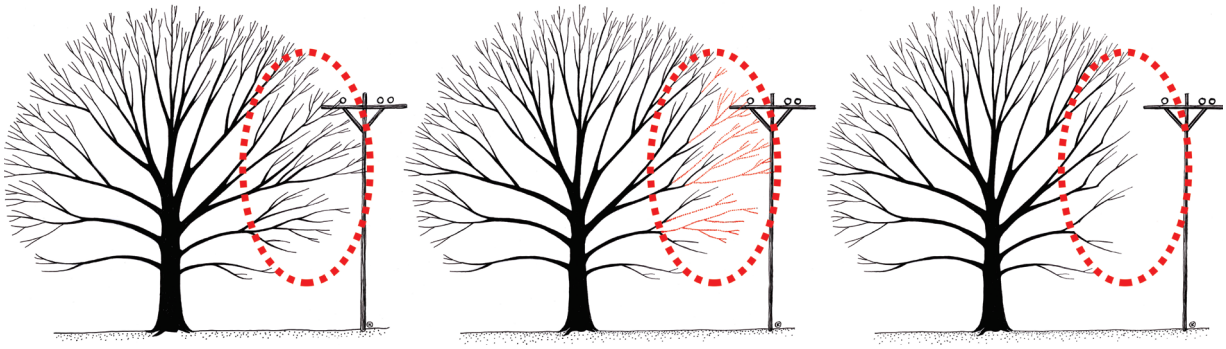
[7] Weak fork: Fork with included bark.

3.4.2 Lateral crown reduction

3.4.2.1 **Objectives:**

- eliminating conflict with surrounding structures, which cannot be removed (branches vs. power lines, building facades or windows etc.),
- improving tree stability (i.e., correcting reduction of top-heavy crowns, correcting destabilised branches etc.),
- maintaining clearance for traffic.

3.4.2.2 This intervention is aimed at the reduction of the side or lower parts of the crown. A lateral crown reduction does not intervene in the top of the crown and does not alter the height of the tree.



PICTURE 15: Lateral crown reduction.

3.4.2.3 All pruning cuts should be as small as possible to achieve the intended outcome.

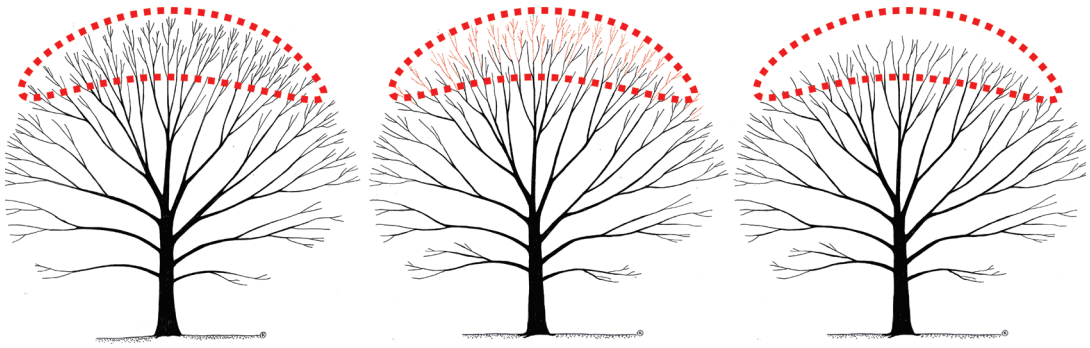
3.4.2.4 It is necessary to consider regrowth as a reaction to the intervention. Therefore, lateral crown reductions will often have to be repeated periodically, to manage the regrowth of the tree.

3.4.2.5 Excessive crown lifting can cause problems with the stability of the tree for various reasons eg. raise of the centre of gravity, change in mass damping etc.

3.4.3 Upper crown reduction

3.4.3.1 **Objectives:** Reduction of the apical, upper part of the crown. This type of pruning intervention is less common and should always be considered along with the need to mechanically stabilise the whole tree or to follow natural crown retrenchment. The aim is not to make trees smaller in the long term, but to keep them at a specific height by repetitive pruning.

3.4.3.2 This is an intervention that often irreversibly affects the architecture of the crown and the physiology of the whole tree. Before considering upper crown reduction, it is essential to consider possible alternatives to achieve the desired mechanical stabilisation.



PICTURE 16: Upper crown reduction.

3.4.3.3 The new outline of the upper crown should respect the original shape of the tree crown or the tree group, taking into account aerodynamics, e.g. sheltering of neighbouring trees, altering of crown dynamics etc.

3.4.3.4 Upper crown reduction should always be part of a long-term tree management plan.

3.4.3.5 Following upper crown reduction, an inspection within 3–5 years should establish:

- have the desired stabilisation objectives been met?
- how has the tree responded and what is the tree's regrowth dynamic?
- what is the extent of dieback and/or bark necrosis (e.g. sun burn)?

Based on this monitoring, the next steps in the tree management plan can be confirmed or modified.

3.4.3.6 The level of necessary upper crown reduction is defined in meters of height reduction, in relation to the original tree height record.

3.4.3.7 If the level of the upper crown reduction can be limited by additional stabilisation by other means (e.g. cabling/bracing etc.), it is advisable to consider a combination of stabilisation measures.

3.4.3.8 It is not advisable to combine an upper crown reduction with simultaneous removal of branches in the lower crown. The aim should be to maintain the maximum possible amount of leaf area.

3.4.4 Crown shaping

3.4.4.1 **Objectives:** Shaping a tree (trimming, pollarding etc.) is a set of interventions that irreversibly alter the tree's natural crown architecture. It must be started when a tree is young and must be sustained for the rest of its life.

3.4.4.2 There are two basic types of tree shaping:

- **pollarding** (knuckle cutting) – repetitive pruning back to the same point(s) with the formation of swollen "knuckles",
- **trimming** – establishment of formal hedge-like trees.

These two basic types can have many variants.

3.4.4.3 Interventions take place at short intervals (often every year). Therefore, it is necessary to consider the cost/benefit balance before initiating tree shaping.

3.4.4.4 It is not advisable to start tree shaping when a tree reaches maturity or later because it will cause extensive injuries and an imbalance between the leaf area and the root system.

3.4.4.5 Establishing an artificial shape in a tree, especially by pollarding, can be confused with topping. In order to establish a pollarded shape, a young tree needs to be topped. The main difference is that shaping is started when the tree is young, and it is done with a clear, long-term objective: to establish a fixed, artificial crown structure that is preserved and reinforced with each pruning intervention.

3.4.4.6 The origin of shaped trees can be found in historical, functional tree use, e.g. for fruit or wood production. These functional pruning styles from long ago have evolved to 'ornamental' pruning styles, establishing artificial tree forms that are not necessarily functional now, but rather have an aesthetic value.

3.4.4.7 The main differences between shaping and topping are:

- establishment in a young tree,
- generally high frequency of pruning (less than 3 years),
- small cuts (less than 5 cm).

In the case of maintaining pollards, pruning intervals can be longer (generally 3–10 years) and the size of cuts can be bigger (but usually less than 10 cm), but the goal of establishing a fixed structure is clearly recognisable as a cultural practice.[8]

3.4.4.8 Topping of (semi-)mature trees without the intent to establish a fixed, artificial form for amenity reasons and without planned and repetitive pruning interventions is considered bad tree work and must be avoided at all times. It leads to large pruning wounds and the associated dysfunction and decay. Topped trees are mutilated trees.

3.4.5 Restorative pruning

3.4.5.1 Restorative pruning is carried out on trees, which have been substantially affected in their physiological and mechanical functions (e.g. because of loss of a substantial part of the crown), either due to a natural damage (e.g. heavy winds) or inappropriate management (e.g. topping, root damage).

3.4.5.2 Trees on which restorative pruning is carried out generally fall into the following categories:

- mismanaged – tree, which has been damaged by inappropriate management interventions,
- lapsed – tree, which suffers from an absence of necessary care (caused by neglect),
- mutilated – tree, which has been significantly affected by storm damage.

Standard pruning techniques may not be applicable to these trees.

3.4.5.3 **Objectives:** If it is possible to convert the tree crown to one of the standard types of care over time (see 3.4.1–3.4.4), this approach is preferred. Otherwise, cost-effective solutions are chosen to ensure tree stability and the longest possible life expectancy, taking into account the tree's benefits at the site.

3.4.5.4 If the benefits of the tree at the site do not justify the cost of its management, the optimal solution could be its removal with compensation by adequate new planting.

3.4.5.5 With age (development stage), the possibility to convert mismanaged/mutilated trees to one of the conventional types of tree management decreases.

3.4.5.6 Mismanaged or mutilated trees may host protected species (mammals, birds, insects, lichens etc.). Their occurrence may change the objectives of the pruning intervention and long-term plans for the tree's retention or removal.

3.4.5.7 When reducing outgrown secondary crowns, reductions below the previous cutting or breakage level should be avoided.

8 National/regional specifics apply. See the national appendices.

4. Tree classification

4.1 Classification according to objective

4.1.1 For the purposes of defining tree pruning interventions, trees are characterised by their status in relation to management objectives.

4.1.2 In order to correctly define pruning operations, it is important to work with long-term objectives in order to achieve a desired 'final image' of what the tree should look like in the future. This can either be:

- a (semi-) natural tree which can develop freely, apart from formative pruning of the young tree to adapt it to restrictions imposed by its surroundings (e.g., proximity to roads, buildings, etc),
- an artificially shaped tree, which is trained to grow in an artificial form through intensive and regular pruning during its entire life, starting from a young age.

4.1.3 Trees can also be neglected (e.g. necessary pruning operations were not performed), mismanaged (e.g. inappropriate and harsh pruning) or mutilated (e.g. damage by storm events or severe root damage during works). This is usually not a desirable situation and the objective for these trees will be to try to manage them towards being a semi-natural or artificially shaped tree.

4.2 Development stage

4.2.1 For the purposes of this standard, development phases of trees are defined in TABLE 3.

4.2.2 Characteristics of development phases may vary between tree species.

4.2.3 **Young and semi-mature trees** have not reached their final height and crown spread, unlike mature trees. This distinctive characteristic is used to evaluate the appropriateness of different pruning interventions.

4.2.4 **Mature trees** are characterised as trees that have reached the maximum crown spread (height and diameter) for their particular taxon, at the specific location and in the context in which they are growing.
A mature tree is reaching the point of delivering its maximum level of benefits for the community. The ultimate objective is to maintain it for as long as possible, with a focus on balancing any risk with the increasing ecosystem service value of the tree.

4.2.5 Within the framework of this pruning standard, a **veteran tree** is characterised as a tree that[9]:

- has reached significant size for the given species,
- has reached significant age for the given species, taking into account its growing conditions and location,
- shows significant increases in biodiversity value (cavities, wood decay etc.),
- may show changes in the crown architecture and a gradual process of natural crown retrenchment (transition from the primary to a secondary crown lower down on the stem and main branches).

4.2.6 Veteran trees often enjoy formal protection in a given country or region which may impose restrictions on the tree work (see also national annex).

4.2.7 Veteran trees are inherently connected with their surroundings, on which they rely for their physiological processes. During pruning and related operations, any changes in site conditions must be carefully considered and minimised if possible.

4.2.8 Special **"veteranisation" techniques** must not be applied to veteran trees. This kind of management should be considered only on the basis of a long-term ecosystem management plan (provided by a specialist) on nearby younger trees. Interventions of this nature are beyond the scope of this pruning standard and must be the subject of specific definition.

TABLE 3: Development phases of trees as used in this standard.

Young tree: characterised by strong apical dominance and hierarchy (the architecture may vary depending on the species).
Semi-mature tree: characterised by weakening of apical dominance, natural appearance of (safe) co-dominance in the upper canopy, but the tree has not reached its final height and crown spread yet.
Mature tree: characterised by having reached its maximal height and typical dimensions (species- and site-specific).
Veteran tree: characterised by considerable size/age for a given species, an advanced life stage and high social, cultural and biodiversity values.

[9] VETcert the following definition of veteran tree was used, encompassing the common features of veteran trees in all partner countries:

- great chronological age for their species,
- in an advanced life stage where they may show retrenchment and have been through phases where they have demonstrated resilience,
- often large for their species,
- showing a complex structure or architecture with hollowing, decay, roots inside the trunk, a colony-tree structure/multiple functional units being common features,
- have high biological/ecological values,
- have a high cultural or heritage value – but this alone does not make a tree a veteran (for example a recently planted tree by a famous person is not a veteran).

Be aware that national and/or legal definitions might be more specific or vary from this definition. It is important to assess each veteran tree individually and to adapt any management to the important features of that specific tree.

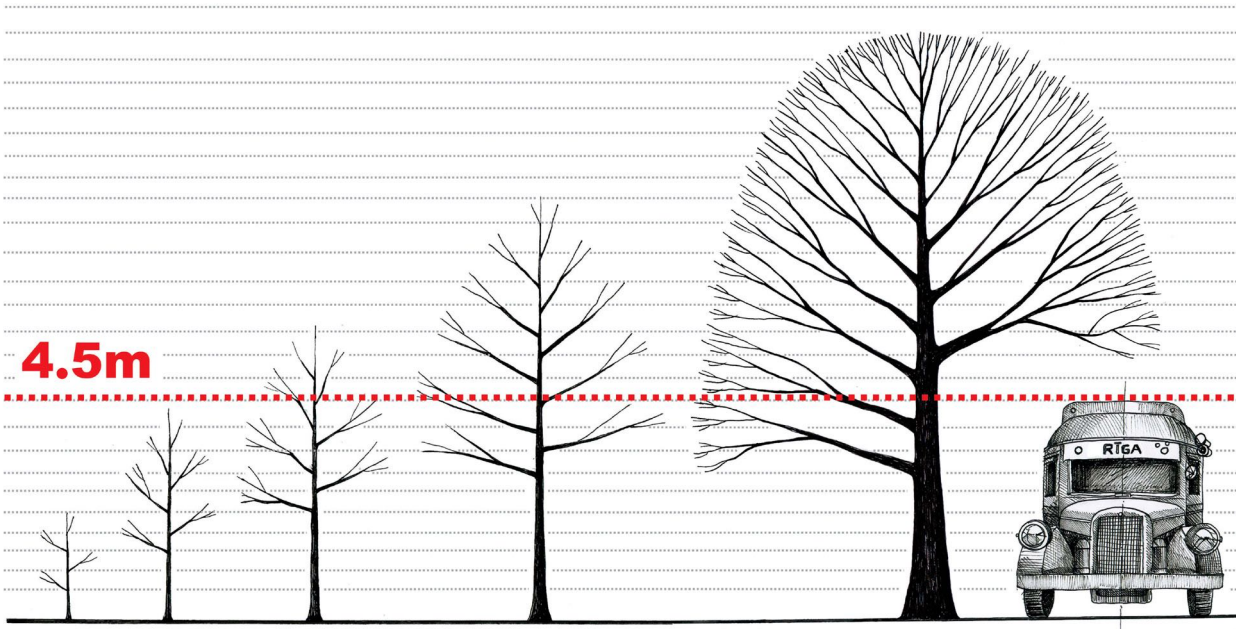
4.3 Temporary vs. permanent crown

4.3.1 Depending on the objectives, we can distinguish between two major crown parts:

- **temporary crown** consists of all branches that are not going to be part of the permanent tree structure. In semi-natural trees these are the branches below the desired clearance height.
- **permanent crown** consists of all branches that will be part of the permanent tree structure. In semi-natural trees these are the branches above the desired clearance height.

4.3.2 Pruning operations and techniques will be different in the temporary crown and the permanent crown (see Tree Pruning Matrix, TABLE 4).

4.3.3 Note that the desired single stem will generally be higher than the clearance (see 5.2).



PICTURE 17: Temporary vs. permanent crown.

4.4 General considerations

4.4.1 Trees are inherently connected with their surroundings, on which they rely on their physiological processes. During pruning and other management operations, any impact on, or changes to, site conditions must be carefully considered and minimised if possible.

4.4.2 A necessary part of tree management planning is to monitor the occurrence of protected species (mammals, birds, insects, lichens etc.) on the tree and in its surroundings, including the specification of measures to safeguard their habitat. This will be increasingly important as trees age.

5. Tree pruning matrix (broadleaved tree species)

5.1 Introduction

5.1.1 For tree pruning by planting refer to EAS:02 – European Tree Planting Standard.

5.1.2 In order to classify the tree pruning system in relation to a tree's status and the pruning objective, a **Tree Pruning Matrix** (TABLE 4) has been developed. Its purpose is to create a systematic approach to defining the appropriate pruning techniques.

5.1.3 General pruning intervals might differ depending on the tree's development phase and the pruning objective. In general:

- formative pruning: regular pruning, small interventions,
- all other types of pruning of (semi-)natural trees: only intervene when necessary,
- artificially shaped tree: periodic pruning with fixed intervals.

5.1.4 During any pruning operation, be aware of the impact on biodiversity. To account for biodiversity, the timing, pruning technique, amount of foliage removed, or any other aspect of pruning might need to be adapted.

5.1.5 The Tree Pruning Matrix generally applies to broadleaved tree species. For a specific approach to palms see Chapter 6.

TABLE 4: Tree Pruning Matrix.

TREE DEVELOPMENT STAGE AND CROWN STATUS

FINAL IMAGE	PRUNING OBJECTIVE	Young/semi-mature tree with temporary crown	Young/semi-mature tree with only permanent crown	Mature tree (only permanent crown)	Veteran tree	Neglected/ mismanaged/ mutilated tree
Semi-natural tree	A: Structural pruning	1/A	2/A	3/A	4	5
	B: Conflict resolution	–	2/B	3/B		
	C: Bio-mechanical stabilisation	–	–	3/B or 3/C		
Shaped tree	D: Shaping	1/D	2/D			6

Notes:

- Trees can be mutilated, neglected or mismanaged as a result of inappropriate human activity or extreme climatic events. This is generally not a desirable state. The primary objective for these trees is to restore them as (semi-)natural or shaped trees through **restorative pruning**.
- **Veteran tree management** is a specialised activity carried out on trees of high cultural, social and biodiversity value. It is recommended that this type of work is specified and carried out by professionals certified as Veteran Tree Specialist (VETcert).

5.2 1/A – Young/semi-mature tree with temporary crown: Formative pruning

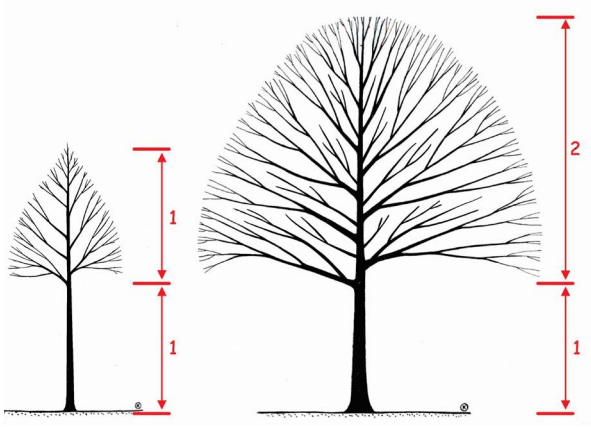
5.2.1 **Objectives:** takes place within the temporary crown of young and semi-mature trees, generally to ensure a dominant stem and working towards a stable and sustainable permanent crown while providing sufficient clearance as the tree develops.

5.2.2 Minimum clearance is defined as:

- pedestrians, cyclists..... 2.5 m,
- vehicles..... 4.5 m.

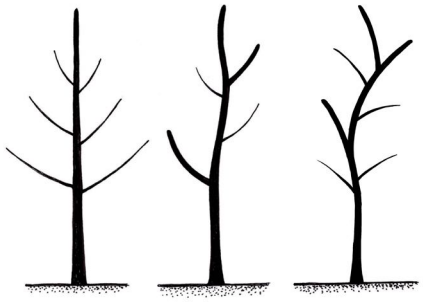
Considering the tendency of branches to bend down over time, it is advisable to aim for a single stem of 3 m (pedestrians) and 5–7 m (vehicles), taking into account the location and the tree species in question.

5.2.3 Crown raising should take place in successive steps, maintaining an acceptable ratio between crown and stem above 2:1 (crown : stem). An exception may apply for young trees, where the ratio can start at 1:1. It is always preferable to leave a larger proportion of the crown.



PICTURE 18: Crown raising.

5.2.4 If present, the dominant leader should always be retained and supported in the temporary crown. Depending on the hierarchy strategy of the tree species, the dominant leader can have several basic forms (see Appendix 3 for the list of tree species according to the hierarchy strategy of the young tree).



PICTURE 19: Various forms of dominant leader architecture.

5.2.5 When pruning, the following branches are considered problematic in the temporary crown and should be removed (in order of priority):

- persistent co-dominant branches, competing with the dominant leader (note that depending on the tree species' specific architecture, temporary co-dominant branches can be a normal and transitory phenomenon),
- thick branches (with an aspect ratio of branch/parent stem over 1:3) in the temporary crown,
- broken, dead or dying branches,
- branches colonised by tree pests or diseases,
- branches with developing/developed weak forks (with included bark),
- rubbing branches,
- epicormic shoots growing on the stem of trees in good physiological condition (for trees in bad physiological condition, these can be managed if necessary and not removed),
- shoots growing below the grafting level (where applicable).

Only when the above branches have been pruned should priority be given to crown raising.

5.2.6 If branches grow in pairs or rings, they should be removed selectively (not all at once) and/or reduced (awaiting full removal) respecting the minimal bark bridge (see 3.2.6.2).

5.2.7 If the permanent crown is present, pruning interventions in the permanent crown must follow guidelines in 2/A (see 5.4).

5.2.8 **Pruning interval:** Formative pruning should start as soon as the tree is established, generally 3 years after planting at the latest.

5.2.9 Formative pruning of young trees is periodic, and pruning should be repeated every 2–3 years, based on the rate of growth and objectives.

5.2.10 **Optimal season:** pruning during the growing season is preferred, but during the dormant period is also acceptable.

5.2.11 **Methods:** Target pruning is the main branch removal method (3.3.2). Pruning to a lateral (3.3.3) is acceptable in justified cases.

5.2.12 Leaf area removal should not exceed 30%. The maximum percentage depends on the physiological condition of the tree and the tree species.

5.3 1/D Young/semi-mature tree with temporary crown: Crown shaping – establishment

5.3.1 **Objectives:** To create an artificial form of the entire crown of a young tree to achieve a desired image of the tree:

5.3.1.1 For **pollard-style trees**, the objective is to establish a fixed and permanent structure by cutting back branches to the same point, where swollen knuckles arise.

5.3.1.2 For **hedge-style trees**, the objective is to establish a dense, hedge-like artificial form by clipping or trimming.

5.3.1.3 Other artificial shapes may be required.

5.3.2 Shaping trees is a set of interventions that irreversibly alters the tree crown architecture and must be performed over regular, short intervals for the rest of the tree's life. Therefore, before establishing an artificial form, a cost/benefit analysis is necessary.

5.3.3 Crown raising may be necessary as part of shape establishment. Due to the development of epicormic shoots on the stem, this will probably have to be regularly repeated.

5.3.4 **Pruning interval:** Pruning cycle is defined in the national appendices, based on the growing pattern of the tree, climatic conditions and cultural habits.

5.3.5 **Optimal season:** Ideal season depends on the desired shape.

5.3.5.1 For **pollarding** the optimal season is the dormant period.

5.3.5.2 **Trimming/clipping** is often repeated several times per year, optimally in the growing season.

5.3.6 **Methods:** For establishing a **pollard-style shape** stub cutting (3.3.7) is the prevailing method; knuckle cut (3.3.4) is used where applicable. Target pruning (3.3.2) is used for complete branch removal.
For establishing **hedge-style trees** trimming cuts (3.3.5) are used.

5.3.7 Usually, the majority of the leaf area is removed by pollarding.

5.3.8 **Critical errors:**
- large pruning wounds,
- lapsed pruning cycle.

5.4 2/A Young/semi-mature tree with only permanent crown: Crown maintenance – young and semi-mature trees

5.4.1 **Objectives:** crown maintenance takes place in the permanent crown, intervening in the crown architecture, with the objective of establishing a sustainable and stable crown structure, as close to the natural tree shape as possible for the tree species.

5.4.2 Naturally occurring co-dominance is tolerated in the permanent crown (depending on tree species and environment). Nevertheless, the top of the crown (dominant leader(s)) must always be retained and supported (no reductions).

5.4.3 When pruning in the permanent crown, the following branches are considered problematic and must be removed or reduced (in order of priority):
- broken, dead or dying branches,
- branches colonised by tree pests or diseases,
- branches or co-dominant shoots with (developing) weak forks (with included bark),
- over-extended branches, in order to prevent future biomechanical problems,
- shoots growing below the grafting level (where applicable).

Depending on tree species and context, rubbing branches can also be considered problematic.

5.4.4 Epicormic shoots in the permanent crown should be left or managed, depending on the tree species, physiological condition and growing context.

5.4.5 **Pruning interval:** pruning is not repetitive, but occasional. On average, the pruning interval will not exceed 5-10 years, depending on the objectives and risk assessment.

5.4.6 **Optimal season:** Ideal season is the growing period, but the dormant period is also acceptable.

5.4.7 **Methods:** Target pruning (3.3.2) and pruning to a lateral (3.3.3).

5.4.8 Leaf area removed should not exceed 20% of overall leaf area (before pruning).

5.4.9 **Critical errors:**
- excessive hit rate (large volume of leaf area removal),
- lion's tailing (clearing of all inner parts of the crown),
- excessive raising of the crown,
- large pruning wounds (over 10 cm diameter).

5.5 2/B Young/semi-mature tree with only permanent crown: Lateral crown reduction

5.5.1 **Objectives:** Reasons for this intervention are mainly resolution of conflicts with surrounding structures or maintaining clearance for traffic.
This intervention is aimed at the reduction of the side or lower parts of the permanent crown. A lateral crown reduction does not intervene in the top of the crown and does not alter the height of the tree.

5.5.2 This pruning technique is usually used in combination with 2/A.

5.5.3 **Pruning interval:** Regrowth is to be expected as a reaction to the reduction. Therefore, interventions will often have to be repeated periodically every 3–7 years (depending on tree species and situation), together with control of the effect of the previous step, until the desired aim is achieved.

5.5.4 At this stage of development, it is usually still possible to influence the architecture of the crown and to permanently resolve or minimise any identified conflicts.

5.5.5 **Optimal season:** Ideal season is the growing period, but the dormant period is also acceptable.

5.5.6 **Methods:** the following branch removal methods can be used:
- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7) in rare, justified cases.

5.5.7 It is advisable to keep the maximum leaf area removed to below 20%; this applies to the total leaf area removed, even when combining multiple techniques.

5.5.8 **Critical errors:**
- excessive hit rate (large volume of leaf area removed),
- creating a significantly unstable asymmetric crown or branches,
- late start to the pruning interventions.

5.6 2/D Young/semi-mature tree with only permanent crown: Crown shaping – maintenance

5.6.1 **Objectives:** Maintain the established crown shape at a defined level (which may slightly increase with each intervention).

5.6.2 Shaping must not be performed below the level of previous pruning point.[10]

5.6.3 Removal of epicormic shoots on the stem may be carried out as part of this intervention.

5.6.4 Dead parts of the crown (stubs) are removed.

5.6.5 **Pruning interval:** Pruning cycle is defined locally (see national appendices) based on climatic conditions and cultural habits.

5.6.6 **Optimal season:** The ideal season depends on the objectives.

5.6.6.1 For **pollarding**, the optimal season is the dormant period.

5.6.6.2 For **hedging**, the reduction may be repeated several times per year; the optimal season is in the growing period.

5.6.7 **Methods:**
- for maintaining a pollard-style shape a knuckle cut, leaving a short stub (3.3.7), is the prevailing method,
- for some traditional cultural types of shaping a rip cut (3.3.6) may also be used,
- for maintaining hedge-style trees trimming cuts (3.3.5) are used.

5.6.8 Usually, pollarding removes most of the leaf area.

5.6.9 **Critical errors:**
- large pruning wounds (over 10 cm diameter),
- lapsed pruning cycle,
- leaving a large number of longer stubs.

10 Exceptions based on the tree species and cultural habits may apply.

5.7 3/A Mature trees: Crown maintenance

5.7.1 **Objectives:** To support a sustainable, stable, permanent crown structure as close to the natural tree shape as possible with respect to the tree's environment. The focus is on ensuring adequate stability and an acceptable level of risk.

5.7.2 The following branches should be considered when pruning:

- branches colonised by tree pests or diseases,
- branches with developed weak forks (with included bark) or other mechanical defects. Where these are of a large size, it is often better to reduce them rather than remove them,
- top-heavy branches should be weight-reduced,
- epicormic shoots in the central crown should be left, depending on the tree species, vitality and growing context.

5.7.3 **Pruning interval:** Pruning is generally not at regular intervals, but occasional. On average, the pruning interval can vary from 1 year (e.g. for deadwood management) to 5–10 years, depending on objectives and risk assessment.

5.7.4 **Optimal season:** Ideal season is the growing period, but the dormant period is also acceptable.

5.7.5 **Methods:** The following branch removal methods can be used:

- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7) and rip cuts (3.3.6) may be considered in rare cases.

5.7.6 Leaf area removed should not exceed 10%.

5.7.7 In rare cases (e.g. diseased branches) it might be necessary to remove large living branches (diameter greater than 10 cm). The preferred method for this is reduction, leaving a large (1–3 m) stub. In these cases, the finishing cut can be a stub cut or a rip cut.

5.7.8 **Critical errors:**

- large pruning wounds (over 10 cm diameter)
- excessive hit rate (large volume of leaf area removed),
- lion's tailing (clearing of all inner parts of the crown),
- excessive raising of the crown.

No upper crown reduction is to be performed as part of crown maintenance.

5.8 3/B Mature trees: Lateral crown reduction

5.8.1 **Objectives:** Reasons for this intervention are mainly improving the tree's stability and resolution of conflicts with surrounding structures or maintaining clearance for traffic.This intervention is aimed at the reduction of the side or lower parts of the permanent crown. Lateral crown reduction does not intervene in the top of the crown and does not alter the height of the tree.

5.8.2 The option for permanent conflict resolution in mature trees may be limited, as the main limb structure is already completely developed.

5.8.3 The physiological and structural impact of the planned lateral crown reduction must be weighed against the value of the tree and the importance of the conflict.

5.8.4 This kind of intervention is usually used in combination with 3/A.

5.8.5 **Pruning interval:** Epicormic regrowth is to be expected as a reaction to the reduction. Therefore, interventions should be repeated periodically every 5–10 years, together with managing the effects of the previous step, until the desired aim is achieved.

5.8.6 **Optimal season:** Ideal season is the growing period, but the dormant period is also acceptable.

5.8.7 **Methods:** The following branch removal methods can be used:

- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7) and rip cuts (3.3.6) may be considered.

5.8.8 It is advisable to keep the maximum leaf area removal below 10%; this applies to the total leaf area removed, even when combining multiple techniques.

5.8.9 **Critical errors:**

- excessive hit rate (large volume of leaf area removed),
- creating a significantly asymmetric crown or branches,
- large pruning wounds (over 10 cm diameter),
- late start to the pruning interventions.

5.9 3/C Mature trees: Upper crown reduction

5.9.1 **Objectives:** This type of intervention on mature trees should only be used in exceptional circumstances and should always be driven by the need to biomechanically stabilise the particular tree. It is important to justify the necessity for upper crown reduction, based on evidence of the instability of the whole tree.

5.9.2 An upper crown reduction must be specified as a result of an estimated (calculated) need to stabilise the tree. The intervention must be limited to the minimum necessary to achieve the desired stabilisation effect and an acceptable level of risk (the use of a standardised calculation method[11] is recommended).

5.9.3 This type of intervention often causes irreversible negative effects on the architecture of the crown and the physiology of the whole tree.

5.9.4 Using additional or alternative techniques to stabilise the tree (cabling/bracing), even if only as a temporary measure, must be considered.

5.9.5 **Pruning interval:** Expect vigorous regrowth as a reaction to the reduction. The tree's reaction to the intervention should be assessed within 3–5 years, with management of its effect.

5.9.6 **Optimal season:** This is not generally defined and depends on the specific situation and tree species (see national appendices).

5.9.7 **Methods:** the following branch removal methods can be used:

- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7),
- rip cut (3.3.6) may be considered.

5.9.8 The leaf area removed should be limited to the estimated (calculated) level required to achieve stabilisation. It is advisable to keep the wound sizes under 10 cm diameter if possible.

5.9.9 Combining upper crown reduction with simultaneous raising of the crown or structural pruning can lead to the massive loss of leaf area and thus should be avoided.

5.9.10 **Critical errors:**

- excessive hit rate: in this case, anything more than the minimum intervention calculated.

5.10 4 Veteran tree management

5.10.1 **Objectives:** Interventions in a veteran tree crown must always be considered carefully and specified. Typically, they focus on the following objectives:

- weight removal or reduction for biomechanical reasons,
- management of epicormic shoots (secondary crown).

5.10.2 Pruning of veteran trees must only be conducted in the context of long-term veteran tree management planning as the objectives of pruning can usually only be achieved in a succession of interventions. It is specialist work, to be conducted by professionals certified for work with veteran trees. (see 2.1.2)

5.10.3 Generally, the intervention is aimed at preserving the internal structures of the crown, including epicormic shoots, according to the development phase and the habitat features of the tree.

5.10.4 The intervention must not adversely affect the significant microhabitats and the biodiversity value of the tree and its surroundings.

5.10.5 **Methods:** the following branch removal methods can be used:

- pruning to a lateral (3.3.3),
- stub cutting (3.3.7),
- rip cut (3.3.6),
- target pruning (3.3.2). Use of target pruning must be carefully considered, since this can involve making larger pruning wounds.

5.10.6 It is advisable to keep the pruning wounds as small as possible. However, making larger wounds may be necessary to achieve the objectives, taking into account the fact that this can result in additional dysfunction and decay in the wound area.

11 The following methods are examples of calculations used to determine the stabilizing effect of tree crown reductions:
SIA – Statisch Integrierte Abschätzung
WLA – Wind Load Analysis
AdBiAn – Advanced Biomechanical Analysis

5.10.7 **Optimal season:** Ideal season is the growing period, but the dormant period is also acceptable.

5.10.8 The pruning interval must be carefully considered in relation to the risk of affecting valuable micro-habitats or specific associated organisms that inhabit the tree and its surroundings.

5.10.9 **Critical errors:**

- excessive hit rate (large volume of leaf area removed),
- complete deadwood removal,
- avoidable removal of, or damage to, habitat features (e.g., deadwood, hollows etc.).

There must be NO crown lifting or removal of epicormic growth in the lower parts of the crown as part of this intervention.

5.11 5 Restorative pruning to restore (semi-) natural tree form

5.11.1 **Objectives:** To restore a mismanaged, neglected or mutilated tree to re-establish a (semi-)natural tree form. Depending on the tree's status, its development phase and the extent of neglect or damage, work may be carried out in the temporary and/or the permanent crown. In each case, the aim is to minimise long-term negative effects of neglect or damage.

5.11.2 The main objectives and techniques comply with categories 1/A, 2/A, 3/A and 4, depending on the tree's status and development stage. Differences in pruning approach are dependent on the extent of neglect or damage and cannot be generalised here.

5.11.3 If the extent of branch defects and physiological or mechanical damage to the tree prohibits the possibility of re-establishing a (semi-)natural tree form, consider the possibility of establishing an artificial tree shape (see 5.12.) or evaluate the benefits of the tree in its environment and either retain it at minimal cost or replace it.

5.11.4 **Pruning interval:** Pruning cycle can range from 1 to 5 years, depending on the objectives and the tree's development stage.

5.11.5 **Optimal season:** Pruning during the growing season is preferred, but the dormant period is also acceptable.

5.11.6 **Methods:** the following branch removal methods can be used:

- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7),
- rip cut (3.3.6).

5.11.7 The amount of leaf area removed is dependent on what is necessary to achieve the objectives. In general, this should not exceed:

- 10% in mature trees,
- 20% in semi-mature trees,
- 30% in young trees,
- in cases of heavily lapsed pruning in vigorous young trees this may be increased up to 40%.

Where trees have low vitality, the hit rate must be carefully considered and, in every case, should be lower than the above.

5.11.8 **Critical errors:**

- re-occurrence of the neglect or mismanagement that led to the damage to the tree.

5.12 6 Restorative pruning to establish an artificial shape

5.12.1 **Objectives:** To restore a mismanaged, neglected or mutilated tree to re-establish an artificial tree shape. Depending on the tree's status, development phase and the extent of neglect or damage, work will be done in the temporary and/or the permanent crown. In each case, the aim is to minimise the long-term negative effects of the neglect or damage.

5.12.2 The main objectives and techniques are consistent with category 2/A or 2/B, depending on the tree's status and development stage. Differences in pruning approach are dependent on the extent of nthe neglect or damage and cannot be generalised here.

5.12.3 If the extent of branch defects and physiological or mechanical damage to the tree prohibits the possibility of establishing an artificial tree shape, evaluate the benefits of the tree in its environment and either retain it at minimal cost or replace it.

5.12.4 **Pruning interval:** Pruning cycle can vary between 1 and 5 years, depending on the objectives and the tree's development stage.

5.12.5 **Optimal season:** Ideal season depends on the desired shape:

- for **pollarding**, the optimal season is the dormant period,
- **trimming/clipping** is often repeated several times per year, optimally in the growing season.

5.12.6 The majority of the leaf area is usually removed by pollarding when establishing an artificial shape.

5.12.7 **Methods:** the following branch removal methods can be used:

- target pruning (3.3.2),
- pruning to a lateral (3.3.3),
- stub cutting (3.3.7),
- rip cut (3.3.6).

5.12.8 **Critical errors:**

- re-occurrence of the neglect or mismanagement that led to the damage to the tree.

6. Taxon-specific approach – Palm trees

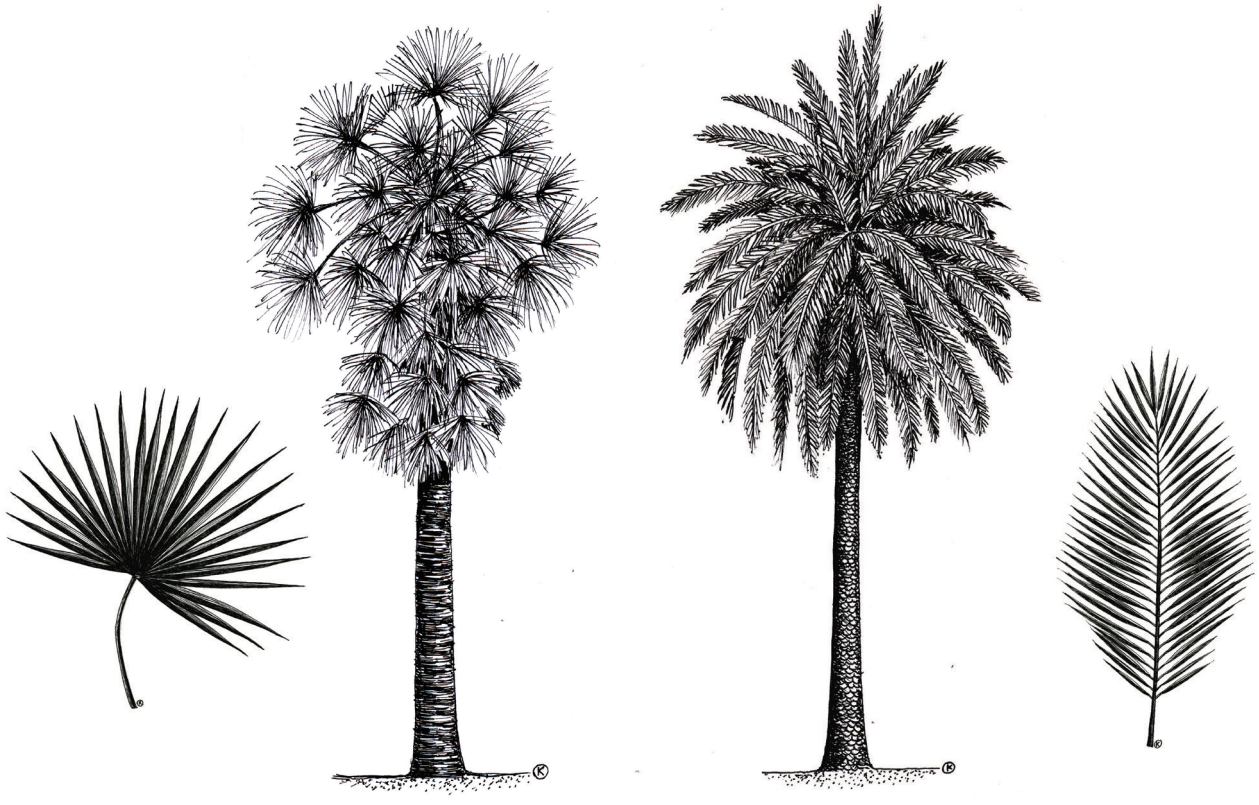
6.1 Introduction

6.1.1 Palms do not have the secondary growth effect that is produced by vascular cambium. This explains the cylindrical shape of the trunk. The trunk is composed of old dried petiole bases tightly stacked on each other and has no bark. Before a young palm gains in height, a certain trunk diameter must first be achieved. Therefore, young palms grow in height much more slowly than older ones. Some species have a stem covered with fibrous threads between the petiole bases; others may lose these fibres on the older parts of the trunk.

6.1.2 Palms always develop one new leaf or "frond" at a time.

6.1.3 The following pruning methods are not necessarily valid for the maintenance of palm trees used in indoor landscaping, or palm trees whose main objective is the production of fruits or other products.

6.1.4 Palm tree species with an ultimate height of less than 4 m are not recommended for planting along roads and in other places where it is necessary to maintain traffic clearance.



PICTURE 20: Variety of basic leaf structure in palm trees.

6.2 Pruning techniques

6.2.1 When pruning palm trees, only the leaves and their remnants, flowers and fruits can be removed. The terminal bud must never be damaged.

6.2.2 The primary objectives of pruning ornamental palm trees, mainly focused on maintenance and cleaning, are to:

- avoid the shedding of leaves or dry fruits of certain species, which could cause damage to people and property,
- limit the weight of palm trees which are at risk of falling or breaking,
- make the palm tree less vulnerable to fires and vandalism,
- remove leaves that, on windy days, can touch power lines, streetlamps, buildings etc.,
- increase the aesthetic value of the specimen and its surroundings,
- remove leaves affected by pests or diseases,
- open an access to facilitate inspections,
- adapt the individual tree to suit the space where it grows.

6.2.3 Knowledge of the biology of the palm species in question is essential in order to manage palm maintenance correctly.

6.2.4 **Dead leaf removal** should be carried out by a clean cut without affecting the living tissues, in such a way as to prevent outflow. Those parts of the petiole that are firmly connected and do not spontaneously fall off should be left on the leaf base. The length of petiole remnants of the individual leaves that are left should be uniform. The choice of the remaining length is based on local habits and the selected aesthetic effect of the pruning.

6.2.5 Dead leaves and their remnants must be cleaned from the stem in order to prevent fires and to limit the occurrence of rodents. Each situation must be evaluated individually. The cover serves as protection against environmental agents and is a place of rich biodiversity. The occurrence of rodents can also be limited by using other techniques.

6.2.6 **Living leaf removal** is performed only exceptionally and where at least one frond (cluster of leaves) is left in the apex of the crown around the central bud. This pruning should not be done systematically, as each individual palm requires an individual approach. If excessive pruning is repeated for several consecutive years, the palm tree weakens, and the diameter of the stipe may decrease, leading to mechanical implications.

6.2.7 Living leaves should not be cut off sensitive palm species as they are more likely to be attacked by pests and diseases. If it is necessary to do so for other reasons, subsequent phytosanitary measures must be carried out throughout the entire crown volume.

6.2.8 **Palm cleaning** is carried out typically on *Phoenix dactylifera* palms. It includes removal of inflorescences and fruits, including their rudiments. This is especially required in tall palms and areas with high targets. Reducing loads on the apex of the stipe helps lower the risk of breakage.

6.2.9 In defined areas with quarantine diseases and pests and in sensitive palm species, cleaning or pruning must always include phytosanitary measures throughout the entire crown volume.

6.2.10 **Stem cleaning** is carried out for aesthetic reasons. The trunk must not be cleaned to a greater extent than is necessary to achieve the desired effect, (living tissues of the trunk must not be affected) up to the area which is already free of leaf residues and their petioles. These are removed only if they separate themselves with ease. Under no circumstances should the adventitious roots that appear on the trunk be cut.

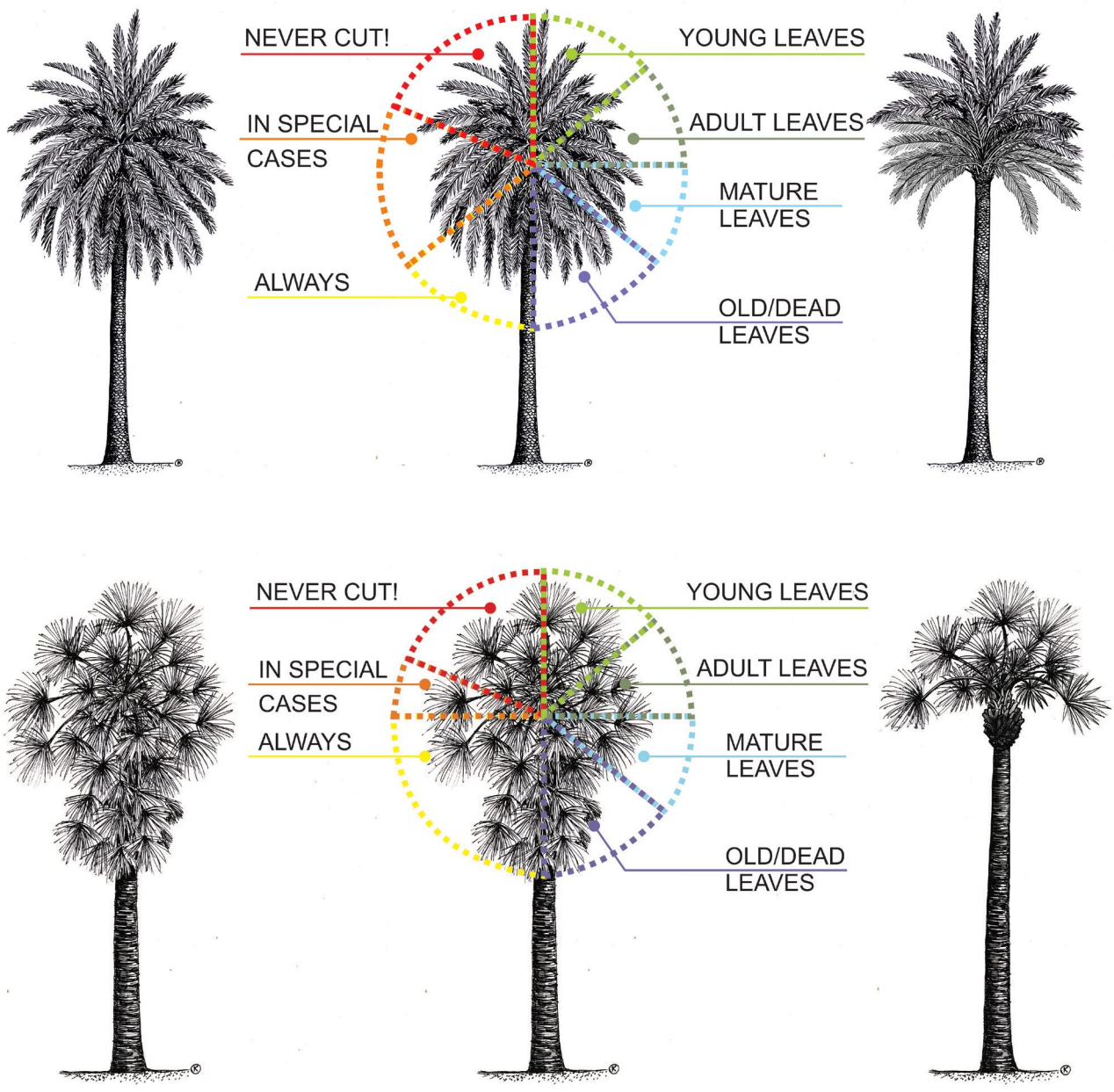
6.2.11 Cleaning must be carried out avoiding injuries to the stem, which may become a gateway for the colonisation of diseases and pests.

6.2.12 For some palm species (*Phoenix dactylifera*), this operation may have a negative effect, as the dry cover provides protection against erosive environmental influences (e.g. in coastal zones).

6.2.13 Removal of the fibre cover of species such as *Trachycarpus fortunei* is generally counterproductive and should only take place in justified cases (e.g. as phytosanitary reasons and risk prevention).

6.2.14 Waste from the pruning should be removed from the site without delay in order to prevent the spread of diseases and pests. If waste has to be left on site for a short time, public access should be prohibited.

6.2.15 Pruning tools must be thoroughly cleaned before working on each palm tree to minimize the risk of disease transmission.



PICTURE 21: General instructions for pruning palm trees.

6.3 Time of pruning

6.3.1 In subtropical and tropical climatic zones, pruning of palm trees can be carried out at any time of the year.

6.3.2 In temperate climatic zones, palm pruning is carried out outside the freezing season, and in colder zones optimally during the summer months.

6.3.3 If the pruning involves removal of green leaves, the treatment should preferably take place during the summer months.

6.3.4 Palm pruning in areas with quarantine pests (especially *Rhychnophorus ferrugineus* and *Paysandisia archon*) must be done outside the period when the flight of adults takes place – optimally from December to February, with immediate application of approved phytosanitary treatment[12] to prevent fruit formation and enhance the vitality of weakened specimens.

6.3.5 Cleaning of palm trees must only be carried out after the inflorescence has been established.

12 Legislative restrictions may apply.

7. Planning and site management

7.1 Introduction

7.1.1 Quality pruning work can be completely invalidated by poor planning and ineffective site management during and after tree pruning operations. This chapter will highlight the main aspects to consider.

7.2 Soil impact

7.2.1 During pruning work, impact on soil quality, which is essential for tree health, must be taken into account throughout the whole operation, including managing arisings.

7.2.2 In order to avoid soil compaction and degradation, carefully plan for the following:

- access onto and off the work site,
- location of fuelling station,
- parking/positioning of equipment (chipper, truck, trailer etc.) and more specifically MEWP (mobile elevating work platforms) positioning, if applicable.

7.2.3 Avoiding soil compaction and degradation might also require changing the timing of the operation (e.g. outside the wet season) or work plan (e.g. type of MEWP used) for the pruning operations.

7.2.4 If soil compaction and degradation cannot be fully avoided, mitigation measures must be put in place.

7.3 Arisings

7.3.1 The treatment of arisings (branches, leaves etc.) is an integral part of the pruning operation. These can be removed, chipped, stacked on site, processed for firewood, etc.

7.3.2. Whenever acceptable, arisings should be used locally to conserve resources on site and support biodiversity[13].

7.4 Impact on neighbouring trees

7.4.1 When planning pruning operations, the impact on neighbouring trees must be taken into account. Neighbouring trees should not be negatively affected by the pruning operations, e.g. by significantly changing wind load distribution. This impact must be taken into account when both planning and performing the pruning operations.

7.4.2 If the impact on neighbouring trees cannot be avoided, mitigation measures must be put in place.

13 Specific details about deadwood management can be found in Deadwood Fact Sheet (see project page).

APPENDICES

Appendix 1: Tree species according to ability to the compartmentalise pruning wounds

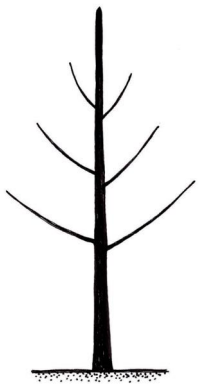
Tree species	Compartmentalisation
Acer campestre	Effective
Acer negundo (Negundo aceroides)	Weak
Acer platanoides	Weak
Acer pseudoplatanus	Effective
Acer rubrum	Effective
Acer saccharinum	Weak
Aesculus spp.	Weak
Ailanthus altissima	Weak
Alnus spp.	Weak
Betula spp.	Weak
Carpinus betulus	Effective
Castanea sativa (C. vesca)	Weak
Cedrus spp.	Effective
Celtis spp.	Effective
Corylus colurna	Effective
Crataegus spp.	Effective
Fagus sylvatica	Effective
Fraxinus spp.	Weak
Gleditsia triacanthos	Effective
Juglans spp.	Weak
Larix decidua (L. europaea)	Effective
Malus spp.	Weak
Paulownia tomentosa (P. imperialis)	Weak
Picea spp.	Weak
Pinus spp.	Effective
Platanus × hispanica (P. × acerifolia)	Effective
Populus spp.	Weak
Prunus spp.	Weak
Pseudotsuga menziesii	Effective
Quercus petraea	Effective
Quercus robur (Q. pedunculata)	Effective
Quercus rubra (Q. borealis)	Weak
Robinia pseudoacacia	Effective
Salix spp.	Weak
Sequoiadendron giganteum (S. gigantea)	Effective
Styphnolobium japonicum	Effective
Sorbus spp.	Weak
Taxus spp.	Effective
Thuja spp.	Weak
Tilia spp.	Effective
Tsuga spp.	Weak
Ulmus spp.	Effective

Appendix 2: Woody plant species with intensive spring sap flow

Acer spp.
Betula spp.
Carpinus spp.
Celtis spp.
Corylus spp.
Cotinus coggygria
Juglans spp.
Liquidambar styraciflua
Morus spp.
Populus simonii
Pterocarya fraxinifolia
Ulmus spp.
Vitis spp.

The sap flow intensity can change in various climatic conditions.

Appendix 3: Tree species according to the basic hierarchy strategy in the young tree

Strategy model A	Strategy model B	Strategy model C
Abies spp. *Acer pseudoplatanus* *Aesculus* spp. *Alnus* spp. *Betula* spp. *Castanea sativa* *Fraxinus excelsior* *Juglans* spp. *Liriodendron tulipifera* *Pinus* spp. *Platanus* spp. *Populus* spp. *Prunus avium* *Salix alba*	*Acer saccharinum* *Acer saccharum* *Ailanthus altissima* *Fraxinus pennsylvanica* *Quercus robur*	*Acer pensylvanicum* *Albizia julibrissin* *Carpinus* spp. *Fagus* spp. *Gleditsia triacanthos* *Morus* spp. *Nothofagus antarctica* *Phellodendron amurense* *Pterocarya fraxinifolia* *Robinia pseudoacacia* *Tilia* spp. *Toona sinensis* *Tsuga canadensis* *Ulmus* spp. *Zelkova serrata*
		

General implications for formative pruning of young trees according to different strategies:

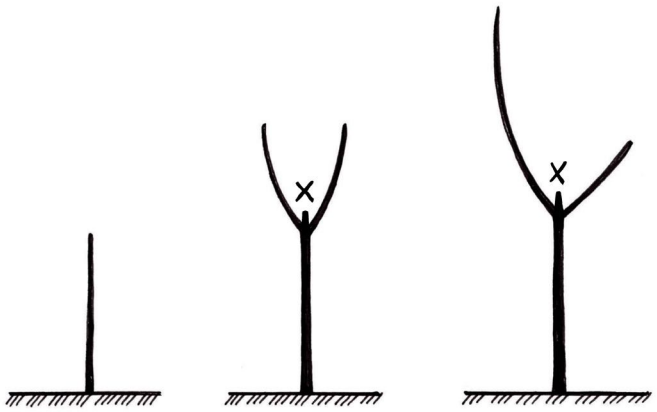
Strategy A
Tree species with strategy A naturally have a strong apical dominance, with a single and upright dominant leader building the stem. If forks appear in the temporary crown of a young tree, this is generally accidental (e.g. damage to the apex of the tree).

During formative pruning tolerance for codominance in the temporary crown should be low: accidental forks, which do not originate from the normal development strategy of the young tree, but were triggered by external factors, should be removed as soon as possible.

Strategy B

Tree species with strategy B build a single stem by transferring the dominance between upright axes, giving rise to transitory recurrent forks in the top of the tree. Generally the apical dominance is rapidly restored as one axis takes over dominance and the others are dominated. The resulting stem of the young trees can temporarily be wavy, less straight than in model A.

During formative pruning, recurrent forks in the top of the tree should not automatically be considered problematic, as their appearance and subsequent resolve are often predictable. Persistent apical codominance in the tree can be resolved by supporting the most dominant axis and reducing the others. Persistent (remains of) recurrent forks in the temporary crown should be reduced or removed, as would be done with any other big, low branch.

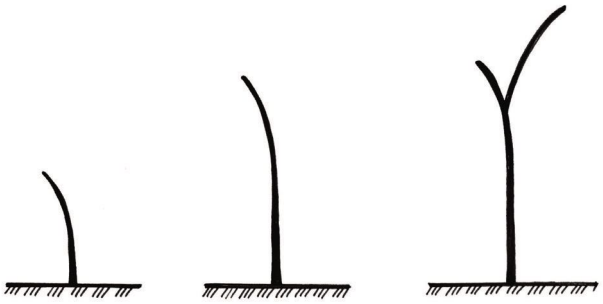


Appearance and resolve of recurrent forks, in young trees according to **strategy B.**

Strategy C

Tree species with strategy C are characterised by the lack of an upright dominant leader: the top of the tree is slanting and has a bilateral symmetry (as opposed to the more typical dominant leaders of trees in strategy A and B, which are upright and have an axial symmetry). The young tree builds a stem by secondarily erecting the basal part of its axes and potentially also by transferring dominance between axes. The dominated axes may remain as thick low branches. These dynamics of growth may result in a tortuous trunk, however, often as the tree increases in girth the tortuousity smoothens.

During formative pruning, a slanting apex and an apparent lack of apical dominance should not automatically be considered problematic, as this is considered to be part of normal development. Persistent codominance in the top of the tree can be resolved by supporting the most dominant axis and reducing the others. Persistent (remains of) dominated axes in the temporary crown should be reduced or removed, as would be done with any other big, low branch.



Slanting axis, secondary basal straightening and transfer of dominance, in young trees according to **strategy C.**

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