BRITISH STANDARD

BS 4043:1989

Recommendations for

Transplanting root-balled trees

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee (BDB/-) to Technical Committee BDB/5, upon which the following bodies were represented:

Arboricultural Association
Association of County Councils
Association of District Councils
Association of Metropolitan Authorities
Building Employers' Confederation
Construction Health and Safety Group
Department of the Environment (Property Services Agency)
Engineering Equipment and Materials Users' Association
Federation of Civil Engineering Contractors
Federation of Manufacturers of Construction Equipment and Cranes
Federation of Piling Specialists
Health and Safety Executive
Incorporated Association of Architects and Surveyors
Institute of Building Control
Institute of Clerks of Works of Great Britain Inc.
Institution of Civil Engineers
Institution of Environmental Health Officers
Institution of Structural Engineers
Landscape Institute
National Council of Building Materials' Producers
National Federation of Demolition Contractors
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Scottish Development Department
Trades Union Congress

The following bodies were also represented in the drafting of the standard, through sub-committees and panels:

Department of the Environment
Department of the Environment (Construction Industries Directorate)
Forestry Commission
Horticultural Trades Association
House Builders' Federation
Institute of Leisure and Amenity Management
Loss Prevention Council
Timber Trade Federation

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Contents

Foreword

This British Standard was prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee. It is a revision of BS 4043:1966, which is withdrawn.

The revision was found necessary because of the changes in techniques, equipment and materials, and a wider availability, since 1966, of planting stock grown specifically for transplanting with a ball of soil around the roots.

This standard recognizes two distinct groups of trees; those which have been prepared for transplanting and those which have received no preparatory treatment. The degree of care when lifting and the aftercare needed are very different for each group of trees.

Attention is drawn to BS 3998, BS 4428 and BS 5837. A British Standard is being prepared concerning grounds maintenance.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

In particular, attention is drawn to the requirements for safety at work under the Health and Safety at Work (Etc.) Act, 1974, and to the Health and Safety (First Aid) Regulations, 1981.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This British Standard gives recommendations for techniques for transplanting trees which are to be moved with a ball of earth around their roots. Particular attention is given to trees whose combined size and weight is such that special equipment is needed to effect the operation. The standard describes their preparation and aftercare.

The techniques described apply also to large shrubs.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

1.2 Planning

1.2.1 Choice between root-balled trees and other nursery stock

Factors that should influence the choice between root-balled trees and other nursery stock (see BS 3936-1) include:

a) whether or not an immediate impact on the landscape is considered essential;

b) the species, varieties and sizes of plants available. There is usually a greater choice of small nursery stock than for larger root-balled trees. Small nursery stock is likely to be the most adaptable to change, provided that the species is suitable for the new soil conditions;

c) conditions at a planting site. Even when ameliorated to as high a standard as it is practical to achieve, soil conditions may still be marginal for healthy root growth, or limit the growth of some species.

1.2.2 Safety precautions

Persons who are transplanting root-balled trees should be given adequate instruction and supervision to ensure that tasks are completed in a safe manner.

First aid equipment should be provided throughout the lifting and transplanting operation, and used in accordance with the Health and Safety (First Aid) Regulations: 1981, and the requirements for safety at work under the Health and Safety at Work (Etc.) Act, 1974, should be satisfied.

All operators should be immunized against tetanus.

1.2.3 Protection of services

Before work is started, all statutory undertakings and pipeline agencies should be contacted. As far as possible the location of all service runs, such as water supply, gas, electricity (overhead and underground), telephone and existing drainage systems (including land drainage, springs and watercourses) should be ascertained. Their location should be marked upon a plan giving their position, size and depth and, if necessary, they should be marked on site and exposed by hand excavations.

When services could be affected by excavation or when machines may be working close to underground services, the services concerned should be carefully sealed off, protected or diverted. Any work of a temporary nature should be made good at completion. Any permanent adjustments should be part of the new works. Adjoining landowners should be kept fully informed.

NOTE In most cases it will be necessary to obtain the approval and assistance of the statutory undertakings and local authorities concerned.

The position of any overhead power lines should be noted at the planning stage. The owners or operators of the lines should be consulted if minimum clearances, 15 m when lines are suspended from steel towers or 9 m for timber poles, cannot be maintained. Reference should be made to the Health and Safety Executive Guidance Note GS6.

Section 2. Supply and handling

2.1 Sources of root-balled trees

Trees to be moved with a ball of earth around their roots should be in one of the following categories:

a) grown in open-ground nurseries at wider than normal spacing to allow for vigorous, balanced crown growth and space for root pruning; or open-ground nursery stock left to grow on at suitably wide spacings after the bulk of the crop has been removed;

b) grown in containers of appropriate size without disturbance; containers will be within or above the ground at suitable spacings to allow for crown development and maintenance;

c) selected from woodland or open-grown sites: trees that are suitable for transplanting after a period of preparation by both root and crown development pruning, are in this category;

d) trees at immediate risk of destruction, especially trees on a development site that are worth the expense of moving to a new site without the benefit of preparation as in c), and despite the high risk of failure [relative to c)].
(See also **2.3.1**.)

2.2 Selection of trees for transplanting

Trees should be individually selected for transplanting and should be true to species and cultivars, vigorous, healthy and undamaged. The form should be typical for the species or cultivar.

NOTE 1 Cohesive soils are the most suitable for forming a root ball. Sands are unsatisfactory as the soil tends to fall away from the roots during lifting, transporting and planting.
NOTE 2 Specimen plants may not be of typical form, i.e. can be selected for specific characteristics, such as a multi-stemmed tree or a tree having an unusual branch habit.

2.3 Preparation of root ball

2.3.1 Importance of root pruning

Trees should be prepared for moving, by root pruning [see **2.1** a) and c)] or transplanting [see **2.1** a), b) and c)]. Sufficient time should elapse between preparation and final lifting to allow for the development of new roots capable of sustaining and continuing the growth of the transplanted tree.

NOTE 1 Omitting root preparation before final lifting will much increase the risk of tree death.
NOTE 2 If a tree has been grown in a nursery or a container where it has been transplanted or root pruned, a compact root ball will usually have been formed. It is possible to achieve an adequate root ball smaller than that referred to in **2.3.4**, provided that the root ball, when finally lifted, is of greater diameter than that of the ball at the last transplanting or pruning.

2.3.2 Trees grown in open-ground nurseries

Trees should be root pruned to a depth of 300 mm to 400 mm.

NOTE The actual depth will depend on soil conditions and cultivation practice.

2.3.3 Container-grown trees

Container-grown trees should be moved with their root balls intact within the containers. The grower's instructions should be observed.

A container-grown tree should be established and have substantial new root growth in the container.

2.3.4 Woodland or open-grown trees

NOTE 1 The root system of a woodland or open-grown tree will normally be widespread. Lifting such trees without initial preparation to produce a root ball will result in much of the root system being left in the soil. When planted the crown may then die back, or the tree may go into check or it may die.

The diameter of the prepared root ball should be at least 10 times the diameter of the stem measured 1 m above the ground.
A trench 300 mm to 750 mm deep (dependent on the species and soil characteristics) should be formed around the bole of the tree, to give a root ball of the appropriate size. All roots protruding from the ball should be cut off cleanly. Preparation should be carried out over two growing seasons by preparing alternate segments in successive years (see Figure 1).

The side of the trench nearest the tree should be lined with a heavy gauge polythene or geotextile material to encourage fibrous root development within the root ball. The trench should be backfilled with non-toxic material.

NOTE 2 A partly prepared specimen may need to be stabilized against the wind until the tree is finally moved.

2.3.5 Trees at immediate risk

Trees at immediate risk of destruction should be moved with as large a mass of undisturbed soil around the roots as possible.

2.4 Season for transplanting

Transplanting should be carried out during the dormant season for the particular species.

NOTE 1 This is normally mid-October to the end of March for deciduous trees and during late winter and spring for evergreens.

Transplanting should be done in weather conditions suitable for the operation.

NOTE 2 Ideal conditions for transplanting are when the weather is dull and the ground is moist and workable. Transplanting can continue during frosty periods if root balls and planting pits and backfill materials are adequately protected from frost.
NOTE 3 Transplanting during the winter can take advantage of frost-bound ground giving better conditions for heavy vehicles to operate. This is of particular importance on sites which are normally soft soils and difficult for access.

If root-balled and container-grown trees, both deciduous and evergreen, are transplanted during the spring and summer, it is essential that aftercare (see **3.3**) should be thorough.

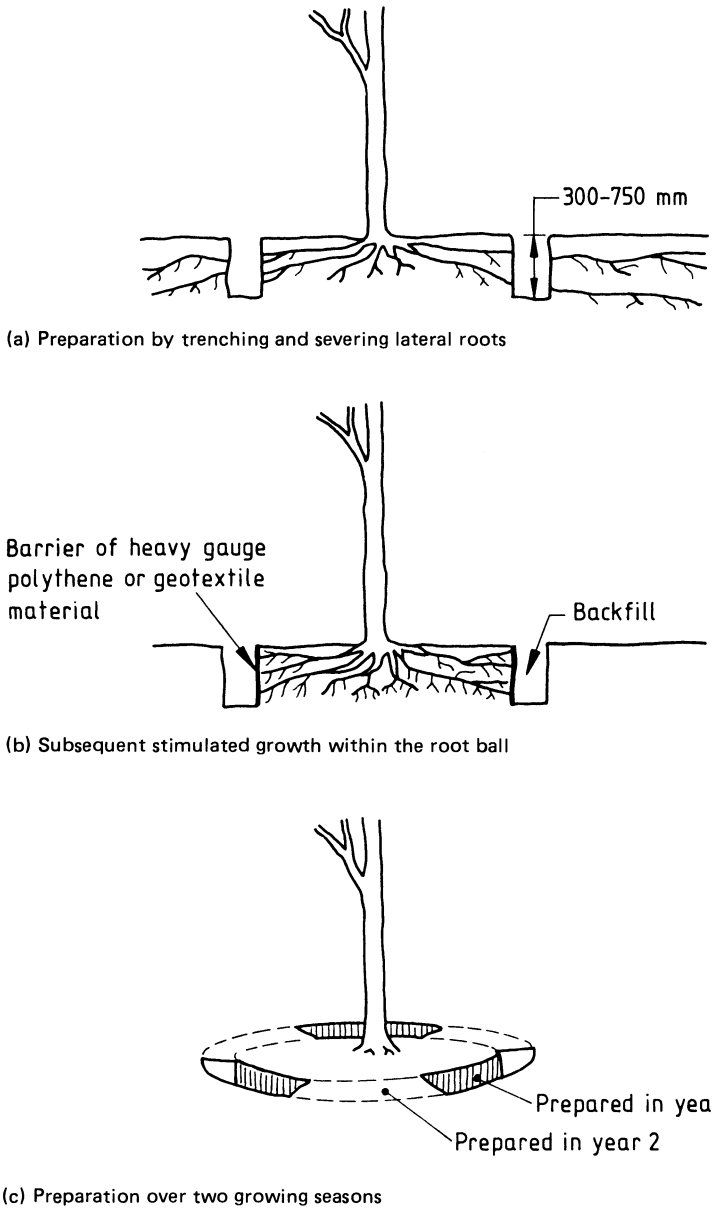


Figure 1 — Preparation of woodland or open-grown trees by root pruning

2.5 Pre-lifting operations

Weed growth should be removed from the root ball or should be treated with herbicide.

Pruning should only be done when necessary to reduce leaf area to compensate expected root loss. Care should be taken to ensure that the special quality for which the specimen may have been selected is not lost by pruning.

NOTE 1 If a deciduous tree is to be moved in full leaf, or if a tree is to be transported some distance, then pruning can reduce the risk of excessive transpirational loss leading to root and shoot death.

Anti-desiccant sprays used should be mixed and applied following the manufacturer's recommendations.

NOTE 2 The efficacy of anti-desiccant sprays when transplanting evergreens, conifers or deciduous trees in leaf is not considered to be proven.

Watering to soak the complete root system at least 24 h before lifting is recommended for some dry soils having low silt or clay content, in dry weather conditions, and particularly for all species when moved at times other than the normal planting season.

Any branches which could be damaged by lifting machinery should be tied in, taking care to avoid bruising or rupturing sensitive bark.

2.6 Lifting and handling of root-balled trees

2.6.1 Handling

Trees should be handled and lifted by the root ball only.

2.6.2 Hand-digging and machine-lifting

A trench should be excavated outside the prepared root ball taking care not to disturb the ball, undercutting if necessary to sever sinker roots. Protective wrappings, such as hessian, should be placed around the root ball and support should be provided with wire netting or by lacing with straps, or by boxing the root ball to ensure that it does not disintegrate during lifting and transporting.

Lifting should be by direct lift, with padded protection for the tree, using a machine of appropriate capacity connected to the support around the root ball, and not to any other part of the tree.

It is essential that self-tightening slings around the bole or branches should not be used as, when tensioned, they will bruise or rupture the bark and could lead to tree death.

When the tree has been lifted, the root ball should be wrapped in heavy gauge polythene to help protect the ball from desiccation during transport.

2.6.3 Integrated systems for lifting and moving trees

NOTE Machines which dig up trees by driving blades into the ground are available for lifting nursery-grown or prepared woodland and open-grown trees. Integrated lifting and moving systems provide a method of quickly digging-up and transporting trees at risk.

The size of the root ball lifted by integrated systems for lifting and moving trees should be as recommended in **2.3**.

When lifting and handling a tree by an integrated system it is important that the root ball should not be released from the protection and support afforded by the blades. When a root ball has to be released from the machine for transport, care should be taken not to damage it. The root ball should be wrapped and constrained with webbing or ungalvanized chain link netting for transport on a separate vehicle to the planting site.

2.6.4 Container-grown trees

Container-grown trees should be moved with their root balls intact within the containers. The grower's instructions should be observed.

2.7 Temporary storage

NOTE Each time a tree is moved there is an increased risk of breaking the root ball and of damaging the trunk and branches.

When a tree cannot be planted as soon as it is delivered, it should be stored upright, in a position where it will be protected from damage and unnecessary movement. Throughout the period of storage, the root ball should be protected from freezing and drying out, using materials and techniques that will not damage the tree.

2.8 Loading and transporting

For long journeys specimens should be placed carefully in a horizontal or nearly horizontal position on a suitable vehicle so that bridges, overhead power lines and other obstacles can be negotiated. Trees should be supported and firmly secured so that they cannot be damaged.

Branches should be tied in to prevent them from being broken and to reduce overhang; padding or wrapping should be used to protect the bark from bruising or rupturing.

Evergreen and deciduous trees in leaf should be completely wrapped to minimize transpiration.

Section 3. Planting and aftercare

3.1 Preparation of planting site

3.1.1 General

A survey of the soil conditions should be made at the planning stage. Trees will not tolerate highly compacted soil, which should be broken up over as large an area of the site as possible.

Planting pits should be provided with drainage to remove excess water.

NOTE It is recommended that professional advice be sought on techniques for overcoming drainage problems. General guidance can also be obtained from BS 4428.

False economies on drainage provision may prejudice the success of a planting operation.

3.1.2 Tree pits

Tree pits should have a diameter at least 500 mm greater than that of the root ball and should be the same depth as the root ball. During digging operations topsoil should be stripped and put to one side for reuse and as much of the indigenous soil as possible should be retained, to avoid a distinct interface between the planting pit and the surrounding soil.

NOTE Shaping the floor of the tree pit to give a domed centre will assist in the final positioning and orientation of the tree.

3.2 Planting

3.2.1 General

Unnecessary movement of a tree should be avoided to prevent disturbance to the root ball. Before unloading or moving a tree from temporary storage, the depth and diameter of the root ball should be measured so that, if necessary, adjustments to the size of the tree pit can be made.

Crown wrappings and fastenings used to tie in the branches for transport should be removed.

Any branches damaged in transit should be removed (see BS 3998).

The tree should be set in the tree pit and should be positioned with the minimum of delay. When finally set, the top of the root ball should not be below the surrounding soil.

3.2.2 Backfilling

Before a tree pit is backfilled all wrapping, insulation material and padding should be removed from around the root ball and from the pit.

NOTE Non-galvanized wire mesh containers can be left in position.

The pit should be backfilled using previously saved soil or, if necessary, an imported soil of similar texture. If considered necessary to improve root growth away from the root ball, a non-bulky organic fertilizer, e.g. Bonemeal, should be mixed with the backfill at the rate of approximately 2 kg/m^3. Backfilling should proceed in layers, with firming, to ensure that no air pockets are left around the root ball. The newly planted tree should be watered slowly to moisten the root ball thoroughly.

3.2.3 Anchoring of root ball

The root ball should be supported to prevent disturbance while new roots develop that will secure the tree in its new site.

NOTE Examples of methods for anchoring of root balls are given in Appendix A.

3.2.4 Mulching

A mulch extending 150 mm beyond the perimeter of the tree pit should be used to conserve moisture and minimize weed growth. Mulches, e.g. pea gravel, ground bark, bitumen felt or ultraviolet stabilized polythene sheeting, should only be applied when the soil is moist.

Granular and loose organic mulches should be at least 50 mm deep.

3.2.5 Protection

Newly planted trees should be protected from stripping of bark by mammals and mechanical damage by grass-cutting machinery. Physical barriers of appropriate materials and size should be constructed to keep mammals away (see BS 1722).

NOTE 1 Wrapping the stems of trees lifted from woodlands has been practised to protect them from sunscorch. There is no evidence for or against the effectiveness of this practice.

NOTE 2 Above-ground support may be sufficient to prevent mechanical damage. Weed-free areas around the tree may obviate the need for machinery to be near the stem base.

3.3 Aftercare

3.3.1 Settlement of the soil

NOTE During the post-planting period (2 years) the backfill around the root ball may settle or contract.

The addition of an organic mulch should prevent the exposed part of the root ball from drying out but more mulch should be added to bring the level to that of the surrounding soil. Sheet mulches may have to be removed to allow soil to be added to restore the level and the sheet should then be replaced.

3.3.2 Weed removal

Any weed growth that develops in the mulched area should be removed by cultivation, herbicides, or the addition of more mulch.

Weed growth should be suppressed for at least 2 years, in an area at least 150 mm beyond the perimeter of the tree pit.

3.3.3 Tree nutrition

When nutrient deficiency is suspected, foliar analysis should be carried out to establish which, if any, nutrients are lacking or are present in an imbalance. The deficiency should be corrected with a suitable regime of fertilizer, provided that the conditions, both of the soil and of the tree, are otherwise satisfactory for tree growth.

NOTE Techniques for applying nutrients and improving soil physical conditions are given in BS 3998.

3.3.4 Branches and bark

Damaged or diseased branches should be pruned and wounds should be treated in accordance with BS 3998.

3.3.5 Watering

Provision should be made for watering, allowing for total wetting of the rooting volume, particularly in drier parts of the United Kingdom and during periods of drought.

3.3.6 Anchors above and below ground

Any movement of the root ball or of the tree base should be investigated. Anchoring systems should be inspected regularly and defects should be made good.

Guys and stakes and ties should be removed, replaced or adjusted as necessary to ensure their effectiveness and to prevent constriction or abrasion damage to the tree.

NOTE Underground securing systems are normally left permanently in position.

Appendix A Techniques for securing root balls

A.1 General

A root ball should be held firmly in place by artificial means until sufficient new roots have developed from the root ball to secure the tree.

A root-balled tree should be anchored either by holding the root ball firmly underground, or by holding the crown steady using stakes and ties or guys.

NOTE Underground methods are preferred for anchoring trees planted in public areas, to remove risk of injury to the general public from guys and stakes.

A.2 Underground anchoring

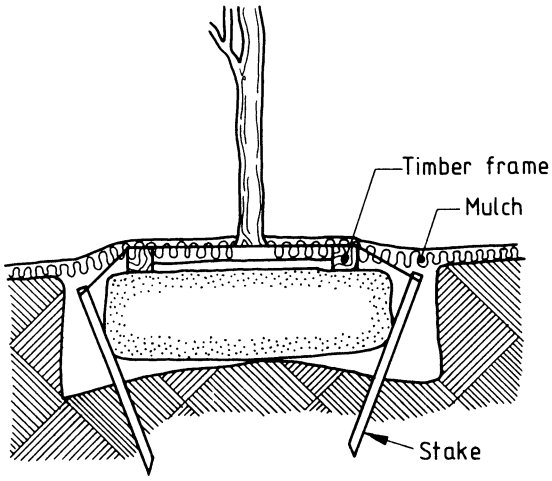
The root ball should be protected by a wooden frame and should be held secure by, for example, cables fastened to stakes driven into the base of the pit (Figure 2), to proprietory anchors or to "deadmen" buried in the pit (Figure 3). Tensioning should be carried out by driving the stakes further into the soil, or by adjusting the turnbuckle, or by drawing the wires or chains together with cross wires.

Alternatively and particularly with smaller trees, a single stake should be driven through the root ball (a guide hole first having been worked with a crow-bar) and the tree should be tied to the stake at up to one-third of the stem height (see Figure 4).

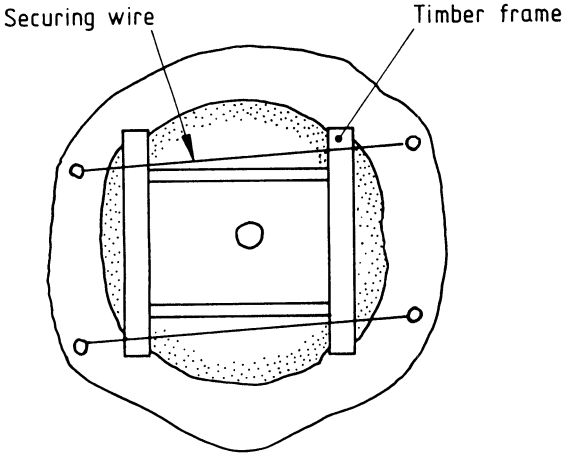
A.3 Overhead anchoring

The root ball should be held firm by tying the lower stem to a cross member supported on two stakes, driven into firm soil either side of the root ball (see Figure 5).

Where three guy wires attached to stakes, "deadmen" or proprietary anchors are used, the guys should be such as to permit adjustment (see Figure 6).

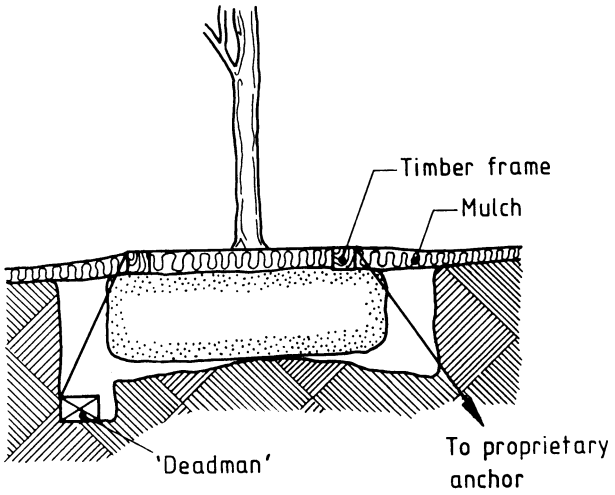


(a) Cross section

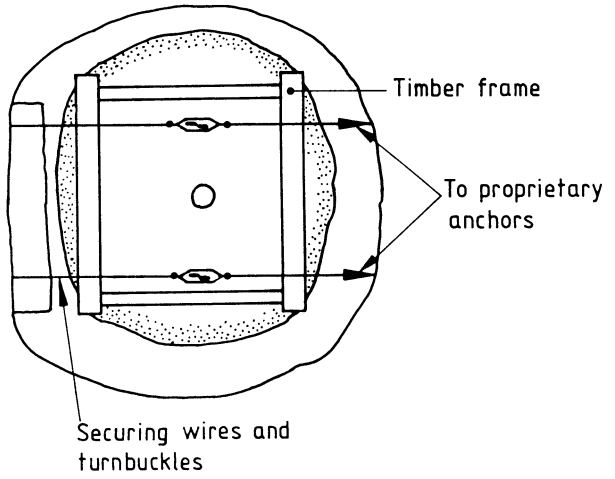


(b) Plan

Figure 2 — Stakes and cables for underground anchoring of root balls



(a) Cross section



(b) Plan

Figure 3 — "Deadmen" or proprietary anchors for underground anchoring of root balls

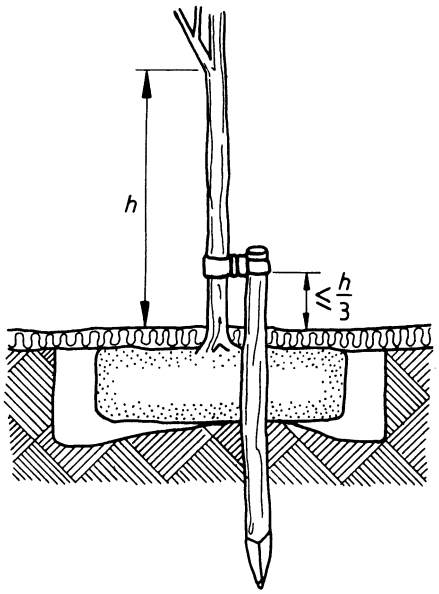


Figure 4 — Single stake driven through root ball into soil

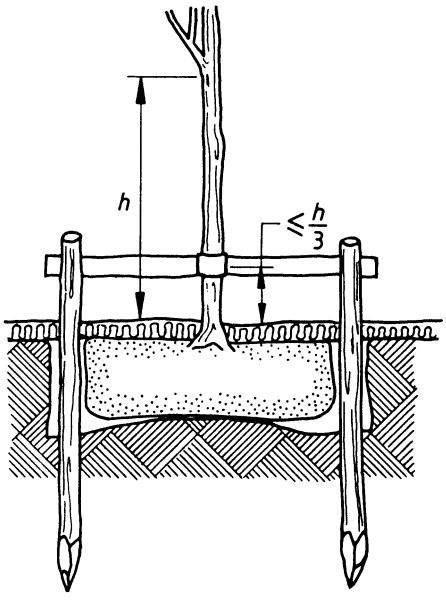


Figure 5 — Tree tied to cross member supported between two stakes

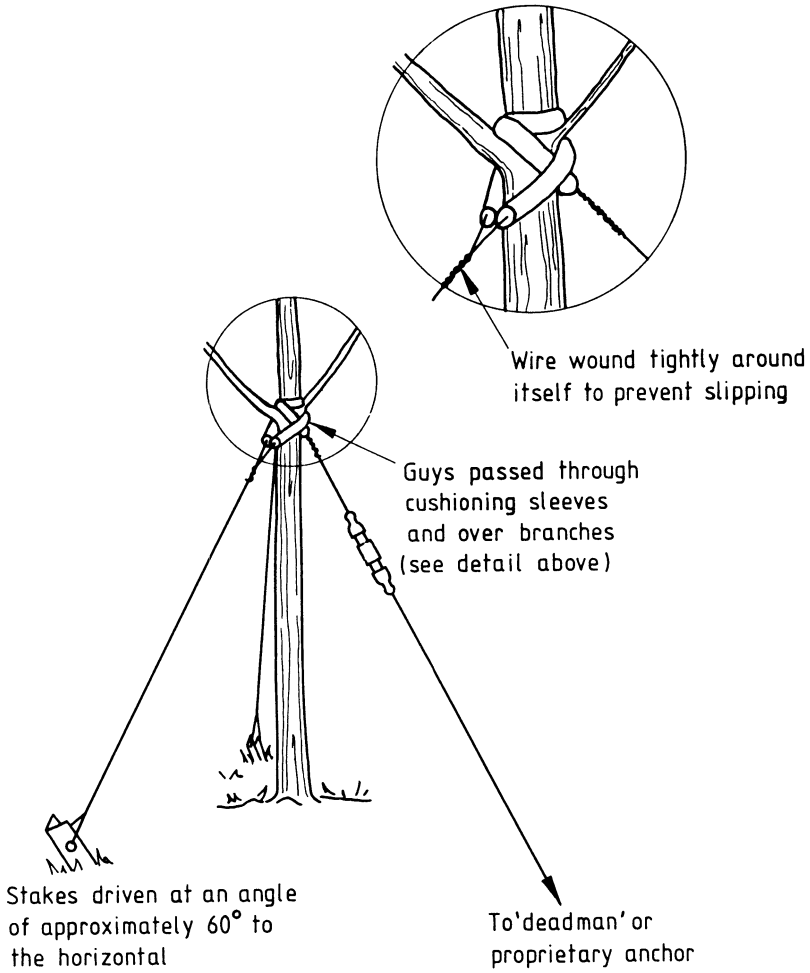


Figure 6 — Overhead anchoring

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Publications referred to

BS 1722, *Fences.*

BS 3936, *Nursery stock.*

BS 3936-1, *Specification for trees and shrubs*[1)].

BS 3998, *Recommendations for tree work.*

BS 4428, *Code of practice for general landscape operations (excluding hard surfaces).*

BS 5837, *Code of practice for trees in relation to construction*[1)2)].

Guidance Note GS6, Avoidance of Danger from Overhead Electric lines, Health and Safety Executive, 1977: HMSO.

[1)] Revisions in preparation. It is intended that the revision of BS 5837 be issued as a British Standard Guide.
[2)] Referred to only in the foreword.

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