Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/213, Trees, upon which the following bodies were represented:

Arboricultural Association
Institute of Leisure and Amenity Management
Institution of Civil Engineers
Institution of Structural Engineers
Landscape Institute
National House-building Council
ODPM — Wildlife and Countryside Directorate
Royal Institute of British Architects (RIBA)
Co-opted members

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15988 Corrigendum No. 1	September 2005	To correct second equation in Table 2, and minor errors in 5.2.4, 11.3.1 and 15.1.5

The following BSI references relate to the work on this standard:
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Contents

Foreword

This British Standard has been prepared by Technical Committee B/213. It supersedes BS 5837:1991 which is withdrawn.

This revision has been found to be necessary to take account of current practice regarding planning for the management, protection and planting of trees in the vicinity of structures, and for the protection of structures near trees.

This standard provides recommendations and guidance for arboriculturists, architects, builders, engineers, land managers, landscape architects and contractors, planners, statutory undertakers, surveyors, and all others interested in harmony between trees and construction.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to competent people (see Clause **2**).

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

Attention is drawn to the following statutory regulations: the Town and Country Planning Act 1990 (as amended) [1], the Forestry Act 1967 (as amended) [2], the Wildlife and Countryside Act 1981 (as amended) [3], the Conservation (Natural Habitats etc.) Regulations 1994 [4], the Countryside and Rights of Way Act 2000 [5], the Hedgerows Regulations 1997 [6], the Construction (Design and Management) Regulations (CDM) [7] and the Environment Act 1994 (as amended) [8].

Annex A provides guidance on aspects of trees and the law.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 32, an inside back cover and a back cover.

1 Scope

This British Standard gives recommendations and guidance on the principles to be applied to achieve a satisfactory juxtaposition of trees, including shrubs, hedges and hedgerows, with structures. It follows, in sequence, the stages of planning and implementing the provisions which are essential to allow development to be integrated with trees.

This standard recognizes that there can be problems of development close to existing trees which are to be retained, and of planting trees close to existing structures. This standard sets out to assist those concerned with trees in relation to construction to form balanced judgements. It does not set out to put arguments for or against development, or for the removal or retention of trees. Where development, including demolition, is to occur, the standard provides guidance on how to decide which trees are appropriate for retention, on the means of protecting these trees during development, including demolition and construction work, and on the means of incorporating trees into the developed landscape.

NOTE A list of organizations from whom additional advice can be obtained is given in Annex B. The Bibliography contains details of publications referred to throughout this document. Other relevant publicly available documents are also listed.

2 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

2.1
arboriculturist
person who has, through relevant education, training and experience, gained recognized qualifications and expertise in the field of trees in relation to construction (see Annex B and the Foreword)

2.2
competent person
person who has training and experience relevant to the matter being addressed and an understanding of the requirements of the particular task being approached (see Foreword)

NOTE 1 A competent person understands the hazards and the methods to be implemented to eliminate or reduce the risks that can arise. For example, when on site, a competent person is able to recognize at all times whether it is safe to proceed.

NOTE 2 A competent person is able to advise on the best means by which the recommendations of this British Standard may be implemented.

2.3
structure
man-made object, such as a building, carriageway, path, wall, services, and built and excavated earthworks

2.4
veteran tree
tree that, by recognized criteria, shows features of biological, cultural or aesthetic value that are characteristic of, but not exclusive to, individuals surviving beyond the typical age range for the species concerned

2.5
root protection area (RPA)
layout design tool indicating the area surrounding a tree that contains sufficient rooting volume to ensure the survival of the tree, shown in plan form in m^2

2.6
tree constraints plan (TCP)
plan prepared by an arboriculturist for the purposes of layout design showing the RPA and representing the effect that the mature height and spread of retained trees will have on layouts through shade, dominance, etc.

2.7
construction exclusion zone
area based on the RPA (in m^2), identified by an arboriculturist, to be protected during development, including demolition and construction work, by the use of barriers and/or ground protection fit for purpose to ensure the successful long-term retention of a tree

2.8
tree protection plan (TPP)
scale drawing prepared by an arboriculturist showing the finalized layout proposals, tree retention and tree and landscape protection measures detailed within the arboricultural method statement (AMS), which can be shown graphically

2.9
arboricultural implications assessment (AIA)
study, undertaken by an arboriculturist, to identify, evaluate and possibly mitigate the extent of direct and indirect impacts on existing trees that may arise as a result of the implementation of any site layout proposal

2.10
arboricultural method statement (AMS)
methodology for the implementation of any aspect of development that has the potential to result in loss of or damage to a tree

NOTE The AMS is likely to include details of an on-site tree protection monitoring regime.

2.11
services
any above ground and piped and/or ducted underground infrastructure including water main, electricity supply, gas supply, fibre-optic utilities, telecommunications cabling, storm and foul water drainage, including temporary storage for run-off, pumping stations, interceptors and other allied buried structures

2.12
special engineering
design of a structure with the physiological requirements of trees as the priority

3 Strategy

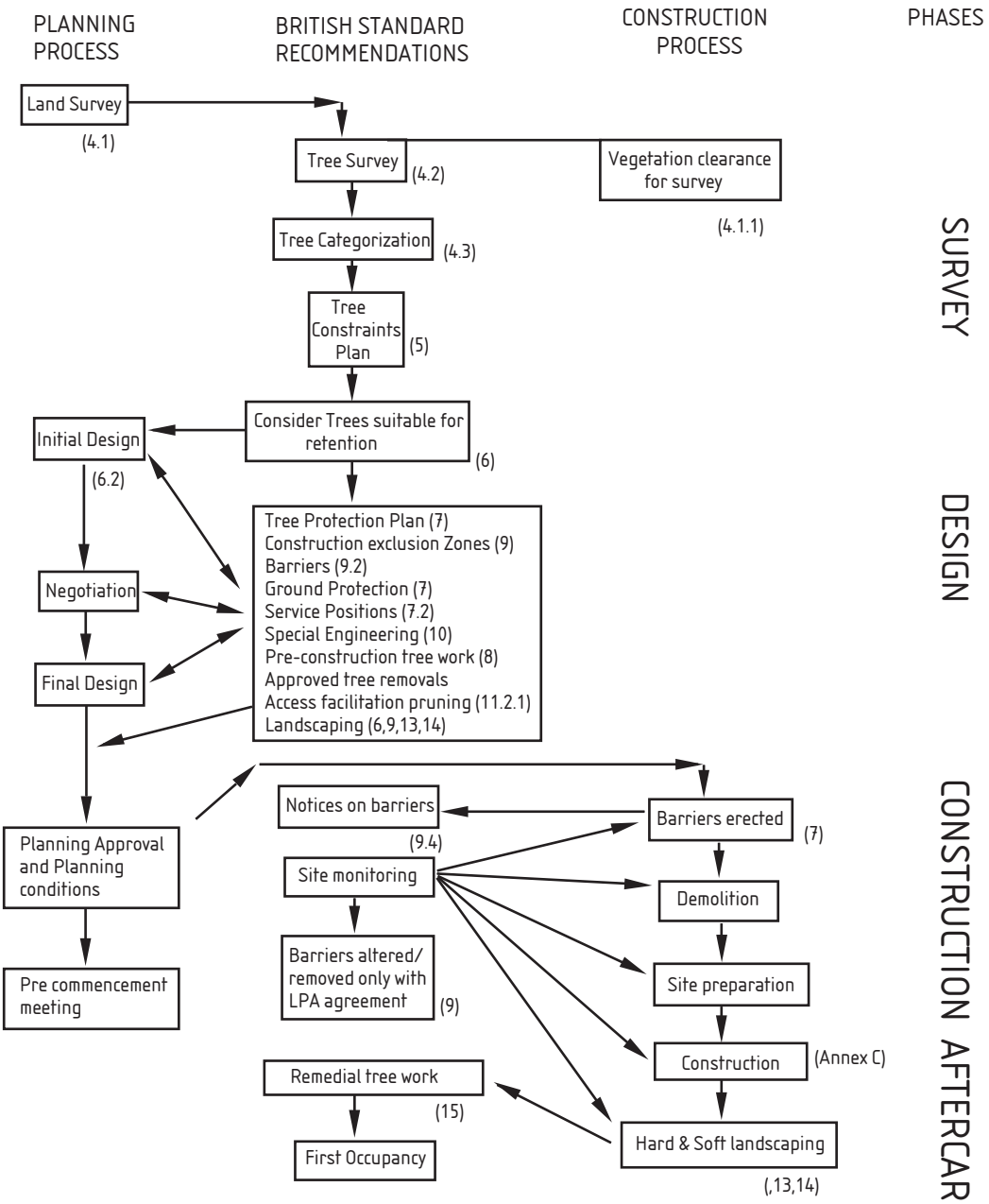
3.1 General

3.1.1 Trees can occupy a substantial part of a development site and because of their potential size can have a major influence on the planning and use of the site. Existing trees of good quality and value can greatly enhance new development, such as by providing an immediate appearance of maturity. However, trees can also be a constraint. Layouts sited poorly in relation to retained trees, or the retention of trees of an inappropriate size or species may be resented by future occupiers and no amount of legal protection will ensure their retention and survival. To avoid such problems and to ensure a harmonious relationship between trees and structures, careful planning and expert advice is needed on their juxtaposition.

3.1.2 A tree may take a century to reach maturity but it can be damaged or felled in a few minutes. Such damage is frequently caused unwittingly because of failure to appreciate the vulnerability of trees, particularly the root system (see Annex C), and how easily and often insidiously they can be damaged. Irreparable damage is frequently done to existing trees in the first few days of a contractor's occupation of a site. The early erection of tree protection to form the construction exclusion zone before works commence on site is essential as the only way to prevent damage being caused to retained trees by operations in their vicinity.

3.2 Implementation

3.2.1 This British Standard provides guidance for a balanced approach on deciding which trees are appropriate for retention, on the effect of trees on design considerations and on the means of protecting these trees during development. This involves a logical sequence of events summarized as a flow diagram (see Figure 1) that has tree care at the centre of the process. Pre planning site discussions involving all parties are recommended.



Figures in brackets refer to Clause numbers.

Figure 1 — Flow diagram, summarizing planning for trees on development sites

3.2.2 The layout of this standard follows the sequence of the flow diagram in Figure 1. Following the land survey (see **4.1**) the existing trees on and adjacent to the site should be surveyed (see **4.2**) and categorized (see **4.3**). The constraints these trees pose should be plotted on a tree constraints plan (see Clause **5**) and those selected for retention should be plotted on a tree protection plan as a result of the negotiations within the design process (see Clause **7**). Areas for new landscaping should be identified at this time (see **6.2.2**). The position of all excavations and any special engineering required can be specified in the form of arboricultural method statements. Once work is due to begin on site the arboriculturist should meet the site agent at a pre start meeting to ensure the correct erection of barriers and ground protection forming the construction exclusion zone (see Clause **9**).

3.2.3 The sequence of events outlined in **3.2.2** may not be necessary for all planning applications. For example, planning applications for a single conservatory may not require the level of detail that needs to accompany a planning application for the development of a site with one or more dwellings.

3.2.4 The success of the process outlined in **3.2.2** depends on the co-operation of all involved in the design and development team which should include an arboriculturist. In particular, it is essential for those involved in the development site works to appreciate the need for maintaining the construction exclusion zone. Any incursion into this area can quickly destroy all of the time, effort and expense which has gone into the retention of the trees.

3.2.5 Local authorities have an important role to play in encouraging and enforcing the processes outlined in **3.2.2**. The means for this are contained in existing regulations (see Annex A), which include provision for local authorities to enforce planning requirements. An arboriculturist appointed by the developer can help monitor site activity but enforcement is the responsibility of the local authority (e.g. active supervision of sites within their areas).

4 Surveys

4.1 Land survey

4.1.1 An accurately measured land survey (also known as a topographical survey) should be undertaken showing all relevant existing site features. Where trees are present, clearance of vegetation to facilitate the survey process should be undertaken only if strictly necessary and with care using hand held machinery. Mechanized flails may be used in more open areas, although bulldozing or soil stripping should be avoided.

4.1.2 This survey should be made available as scale drawings and in a commonly agreed digital format, if available, before any application for planning permission is submitted. Computer-based drawing software should be used where possible.

4.1.3 Prior to commencing the topographical survey, it may be appropriate to seek the advice of an arboriculturist to identify all trees that are relevant for inclusion in the survey. Alternatively, the topographical survey should include all trees present, and certainly all those over 75 mm stem diameter, measured at 1.5 m above adjacent (higher) ground level. Trees over this size growing on land adjacent to the site, which are at or within a distance equal to 12 times their stem diameter from the boundary (or 10 times their base diameter, in the case of multi-stemmed trees), or where their crowns overhang the site boundary, should also be included. For trees with more than one stem below 1.5 m above ground level, the stem diameter should be measured immediately above the root flare.

4.1.4 Other arboricultural or landscape features such as shrub masses or hedges should also be identified. The position of stumps should be included.

4.1.5 To summarize, the land survey should include:

a) the location of all trees, shrub masses, hedges etc., as identified in **4.1.3** and **4.1.4**;

b) other relevant features, such as streams, buildings and other structures, boundary features, trenching scars near to trees and services including drainage runs;

c) spot heights of ground level throughout the site, as a basis for avoiding changes in soil level around retained trees;

d) the approximate location of trees on land adjacent to the development site (see **4.1.3**), that might influence the site or might be important as part of the local landscape character.

4.2 Tree survey

4.2.1 A tree survey should be undertaken by an arboriculturist and should record information about the trees on a site independently of and prior to any specific design for development. [As a subsequent task, and with reference to a design or potential design, the results of the survey should be included in the preparation of a tree constraints plan (TCP), which should be used to assist with site layout design (see Clause **6**)].

NOTE For clearance of vegetation see **4.1.1**.

4.2.2 The tree survey should include all trees included in the land survey (see **4.1.3** and **4.1.4**), as well as any that may have been missed, and it should categorize trees or groups of trees, including woodlands (see **4.2.4**) for their quality and value within the existing context, in a transparent, understandable and systematic way. Where the arboriculturist deems it appropriate, the trees should be tagged with small metal or plastic tags, placed as high as is convenient on the stem of each tree.

4.2.3 Whilst master plan proposals for the development of the site might be available, the trees should be surveyed without taking these into consideration. All detailed design work on site layout should take into consideration the results of the tree survey (and the TCP) as this facilitates the logical sequence of events referred to in **3.2.2** and the flow diagram in Figure 1.

4.2.4 Trees forming groups and areas of woodland (including orchards, wood pasture and historic parkland) should be identified and considered as groups where the arboriculturist determines that this is appropriate, particularly if they contain a variety of species and age classes that could aid long-term management. It may be appropriate to assess the quality and value of such groups of trees as a whole, rather than as individuals. However, an assessment of individuals within any group should still be undertaken if they are open-grown or if there is a need to differentiate between them.

4.2.5 The quality and value of each tree or group of trees should be recorded by allocating it to one of the four categories listed in **4.3.1**. The categories should be differentiated on the tree survey plan by colour, or by suffixing the category adjacent to the tree identification number on the tree survey plan (see **4.2.6**).

NOTE Suggested colours are given in Table 1.

4.2.6 A schedule to the survey should list all the trees or groups of trees. The following information should be provided:

a) reference number (to be recorded on the tree survey plan);

b) species (common and scientific names, where possible);

c) height in metres;

d) stem diameter in millimetres at 1.5 m above adjacent ground level (on sloping ground to be taken on the upslope side of the tree base) or immediately above the root flare for multi-stemmed trees;

e) branch spread in metres taken at the four cardinal points to derive an accurate representation of the crown (to be recorded on the tree survey plan);

f) height in metres of crown clearance above adjacent ground level (to inform on ground clearance, crown stem ratio and shading);

g) age class (young, middle aged, mature, over-mature, veteran);

h) physiological condition (e.g. good, fair, poor, dead);

i) structural condition, e.g. collapsing, the presence of any decay and physical defect;

j) preliminary management recommendations, including further investigation of suspected defects that require more detailed assessment and potential for wildlife habitat;

k) estimated remaining contribution in years (e.g. less than 10, 10–20, 20–40, more than 40);

l) R or A to C category grading (see Table 1) to be recorded in plan on the tree survey plan.

NOTE 1 An example tree survey pro forma is given in Annex D (see also BS EN ISO 11091).

NOTE 2 It may be appropriate to assess and list the amenity value of trees as a separate consideration. Various methods have been proposed as aids to making this assessment (see Annex B for arboricultural organizations).

4.3 Tree categorization method

4.3.1 Trees should be categorized in accordance with the cascade chart in Table 1.

Table 1 — Cascade chart for tree quality assessment

TREES FOR REMOVAL				
Category and definition	**Criteria**			**Identification on plan**
Category R Those in such a condition that any existing value would be lost within 10 years and which should, in the current context, be removed for reasons of sound arboricultural management	• Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other R category trees (i.e. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning) • Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline • Trees infected with pathogens of significance to the health and/or safety of other trees nearby (e.g. Dutch elm disease), or very low quality trees suppressing adjacent trees of better quality NOTE Habitat reinstatement may be appropriate (e.g. R category tree used as a bat roost: installation of bat box in nearby tree).			DARK RED
TREES TO BE CONSIDERED FOR RETENTION				
Category and definition	**Criteria — Subcategories**			**Identification on plan**
	1 Mainly arboricultural values	**2 Mainly landscape values**	**3 Mainly cultural values, including conservation**	
Category A **Those of high quality and value:** in such a condition as to be able to make a substantial contribution (a minimum of 40 years is suggested)	Trees that are particularly good examples of their species, especially if rare or unusual, or essential components of groups, or of formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue)	Trees, groups or woodlands which provide a definite screening or softening effect to the locality in relation to views into or out of the site, or those of particular visual importance (e.g. avenues or other arboricultural features assessed as groups)	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)	LIGHT GREEN
Category B **Those of moderate quality and value:** those in such a condition as to make a significant contribution (a minimum of 20 years is suggested)	Trees that might be included in the high category, but are downgraded because of impaired condition (e.g. presence of remediable defects including unsympathetic past management and minor storm damage)	Trees present in numbers, usually as groups or woodlands, such that they form distinct landscape features, thereby attracting a higher collective rating than they might as individuals but which are not, individually, essential components of formal or semi-formal arboricultural features (e.g. trees of moderate quality within an avenue that includes better, A category specimens), or trees situated mainly internally to the site, therefore individually having little visual impact on the wider locality	Trees with clearly identifiable conservation or other cultural benefits	MID BLUE
Category C **Those of low quality and value:** currently in adequate condition to remain until new planting could be established (a minimum of 10 years is suggested), or young trees with a stem diameter below 150 mm	Trees not qualifying in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater landscape value, and/or trees offering low or only temporary screening benefit	Trees with very limited conservation or other cultural benefits	GREY
	NOTE Whilst C category trees will usually not be retained where they would impose a significant constraint on development, young trees with a stem diameter of less than 150 mm should be considered for relocation.			

4.3.2 The purpose of the tree categorization method, which should be applied by an arboriculturist, is to identify the quality and value of the existing tree stock, allowing informed decisions to be made concerning which trees should be removed or retained should development occur.

4.3.3 For a tree to qualify under any given category it should fall within the scope of that category's definition (R, A, B, C) and, for a tree in categories A–C, it should qualify under one or more of the three subcategories (1, 2, 3).

4.3.4 In the categories A, B, C, which together deal with trees that should be a material consideration in the development process, the subcategories are intended to reflect arboricultural, landscape and cultural values respectively. Category R trees are those which would be lost in the short term for reasons connected with their physiological or structural condition. For this reason, they should not be a consideration in the planning process (see note to **6.1**).

4.3.5 The tree survey schedule should list which subcategory applies. It is intended that each subcategory has equal weight such that, for example, an A1 tree has the same retention priority as an A2 tree. Some trees could qualify under two or even three criteria, e.g. A1 and 2 but would not accrue added value.

4.3.6 When determining the appropriate category for any given tree, group or woodland, the arboriculturist should start by determining whether the tree falls within the scope of the R category. Assuming that the tree can be retained, the arboriculturist should then proceed on the presumption that all trees are considered according to the criteria for inclusion in the high category. Trees that do not meet these strict criteria should then be considered in light of the criteria for inclusion in the moderate category. This cascade process should be repeated, as required, until the appropriate quality and value assessment is reached.

NOTE The term "group" is intended to identify trees that form cohesive arboricultural features either **aerodynamically** (e.g. trees that provide companion shelter), **visually** (e.g. avenues or screens) or **culturally** including for biodiversity (e.g. parkland or wood pasture), in respect to each of the three subcategories.

4.3.7 When assigning trees to any of the categories, the presence of any serious disease or tree-related hazards should be taken into account. If disease is fatal and/or irremediable or likely to require sanitation for the protection of other trees, the trees concerned may need to be categorized as R, even if they otherwise have considerable value. If mechanical defects present an unacceptable risk to people and property, the extent to which the defects are remediable, including the effect that this might have on the tree's remaining value, should indicate whether the tree should still be assigned to the category that it would otherwise merit.

NOTE If a layout design places category R trees in an inaccessible location such that concerns over public safety are reduced to an acceptable level, it may be preferable or possible to defer the recommendation to fell.

4.4 Additional considerations

4.4.1 During the course of a tree survey, it might be found that certain trees require immediate attention. For example, they might present an immediate and serious hazard to life or property, or they might be affected by a pest or pathogen which would cause widespread and serious damage unless eradicated. These issues should be brought to the attention of the appropriate party as soon as possible.

4.4.2 Particular care is needed when considering the quality and value category of young trees, especially where they occur as individual specimens. Where these are less than 150 mm stem diameter (at 1.5 m above adjacent ground level), it may be relatively straightforward to relocate them within the site (e.g. using a tree spade) or to replace them with similar replacement trees. Whilst the presence of young trees of good form and vitality is generally desirable (i.e. those trees which have the potential to develop into quality mature specimens), they should not be allowed to dominate site layout considerations. When evaluating the merits of retaining and/or relocating such trees, a comparison between the costs of the various options should be the main determining factor. However, they should be categorized as C grade trees.

NOTE It is sometimes possible to relocate mature trees. However, as this is a costly and complex operation with a variable chance of success, it is only a viable option in exceptional cases.

4.4.3 The tree survey may identify the presence of veteran trees on the site. Such trees should be considered carefully in relation to new development, as it is rarely acceptable to locate them within developed areas, rather than open space. The implications of their presence on the land use of the surrounding site should be assessed at the earliest possible stage of the planning process. Veteran trees should be assessed according to the recommendations in **4.3.1**. By this assessment, most genuine veteran trees are likely to be included in category A3.

4.5 Tree survey — post-planning

It is recognized that, on occasions, arboricultural advice is not sought until after a preliminary site layout has been prepared. Although this is not the ideal situation, timely and appropriate expert advice can still make a valuable contribution to the process of tree retention and protection. In cases where the arboriculturist is provided with a layout, the tree survey should be undertaken as described in **4.2** to provide advice on tree retention, protection, remedial or mitigation works and new landscape design. It is essential that the trees are assessed objectively and without reference to site layout proposals.

5 Tree constraints plan

5.1 General

The influence that trees on and adjacent to the site will have on the layout should be plotted on a plan called the tree constraints plan (TCP). This is a design tool which should show the below ground constraints, represented by the RPA, and the above ground constraints the trees pose by virtue of their size and position.

5.2 Root protection area (RPA)

5.2.1 In order to avoid damage to the roots or rooting environment of retained trees, the RPA should be plotted around each of the category A, B and C trees (see **4.3**). This is a minimum area in m^2 which should be left undisturbed around each retained tree.

5.2.2 The RPA should be calculated using Table 2 as an area equivalent to a circle with a radius 12 times the stem diameter for single stem trees and 10 times basal diameter for trees with more than one stem arising below 1.5 m above ground level.

Table 2 — Calculating the RPA

Number of stems	Calculation
Single stem tree	$\text{RPA}(m^2) = \left(\frac{\text{stem diameter (mm) @ 1.5 m} \times 12}{1\ 000}\right)^2 \times 3.142$
Tree with more than one stem arising below 1.5 m above ground level	$\text{RPA}(m^2) = \left(\frac{\text{Basal diameter (measured immediately above root flare (mm)} \times 10}{1\ 000}\right)^2 \times 3.142$
NOTE The 12× multiplier is based on NJUG 10 [9] and published work by Matheny and Clark [10].	

5.2.3 The calculated RPA should be capped to 707 m^2, e.g. which is equivalent to a circle with a radius of 15 m or a square with approximately 26 m sides.

5.2.4 The RPA, for each tree as determined in Table 2, should be plotted on the TCP taking full account of the following factors, as assessed by an arboriculturist, which may change its shape but not reduce its area whilst still providing adequate protection for the root system.

a) The likely tolerance of the tree to root disturbance or damage, based on factors such as species, age and condition and presence of other trees. (For individual open grown trees only, it may be acceptable to offset the distance by up to 20 % in one direction.) (See Note 1 of **11.3.5**.)

b) The morphology and disposition of the roots, when known to be influenced by past or existing site conditions (e.g. the presence of roads, structures and underground services).

c) The soil type and structure.

d) Topography and drainage.

e) Where any significant part of a tree's crown overhangs the provisional position of tree protection barriers, these parts may sustain damage during the construction period. In such cases, it may be necessary to increase the extent of tree protection barriers to contain and thereby protect the spread of the crown. Protection may also be achieved by access facilitation pruning (see **11.2.1**). The need for such measures, including the precise extent of pruning, should be assessed by an arboriculturist.

5.3 Above ground constraints

5.3.1 The current and ultimate height of category A, B and C trees should be annotated on the tree constraints plan (TCP) where this would cause unreasonable obstruction of sunlight or daylight to the development. In practice this could be represented by a segment with a radius from the centre of the stem equal to the height of the tree drawn from due North West to due East indicating the shadow pattern through the main part of the day.

NOTE 1 This varies between species and depends on foliage size and density (see BRE 350 [11]).

NOTE 2 The spatial relationship of the proposed development to the tree(s) affects the amount of sunlight received, the amount of sky visible from the development and the solar gain received by the development (see BRE 209 [12]).

NOTE 3 Proprietary software is available that can assist with calculation and plotting of tree shadow extent (see also BRE CP75/75 [13]).

5.3.2 The current and ultimate height and spread of a tree is also a constraint due to its size, dominance and movement in strong winds. For this reason, as well as in relation to shading, the existing spread of branches and the future branch growth should be taken into consideration as a constraint in the design phase.

6 Arboricultural implications assessment (AIA) and design issues

6.1 General

Whilst the tree constraints plan (TCP) should inform site layout design, it is recognized that the competing needs of development mean that trees are only one factor requiring consideration. Certain trees are of such importance and sensitivity as to prevent development occurring or to substantially modify its design and layout. However, care should be taken to avoid misplaced tree retention; attempts to retain too many or unsuitable trees on a site may result in excessive pressure on the trees during development work and subsequent demands for their removal. The end result may be fewer or less suitable trees than would be the case if arboricultural input, planning, selection, conservation and new planting is incorporated into the approved final design.

NOTE Trees are material considerations in the formal planning system, whether or not they are statutorily protected.

6.2 Tree constraints and design

6.2.1 Trees can impinge on many aspects of site development. Adequate consideration should be given to the requirements of trees by all members of the design team throughout the development process.

6.2.2 Even if there are no trees on the site, areas for future planting should be plotted on the tree constraints plan (TCP) and protected from damage, especially soil compaction due to construction activity, by the erection of barriers and/or ground protection (see **7.1**). Where such pre development protection is not implemented, prior remediation measures should be employed, such as soil ripping with a winged-tined plough or subsoil aeration.

6.2.3 During the design and planning stages the following factors should be taken into account.

a) The presence of tree preservation orders or conservation area protection.

b) The effect that development proposals may have on the amenity value of trees, both on and near the site.

c) The above and below ground constraints (see Clause **5** and **6.3.2**).

d) The construction of the proposed development (see **7.2**).

e) Whether the design and/or construction of the proposed development can be modified to accommodate retention of trees that would otherwise be at risk or lost. This includes appropriate tree surgery works that acceptably mitigate adverse effects caused by trees.

f) Infrastructure requirements, e.g. easements for underground or above ground services; highway safety and visibility splays; and other infrastructural provisions, such as substations, refuse stores, lighting, signage and CCTV requirements.

g) The end use of the space.

h) Whether tree loss resulting from the development proposals can be acceptably mitigated by new tree planting.

NOTE There is a need to avoid the cumulative damaging effects of incursions into the RPA, for example from excavation for services and the laying of permanent hard surfaces.

6.2.4 Particular care is needed regarding the retention of large old trees which become enclosed within the new development. Such trees may be less resilient and more likely to die or become potentially unsafe as a result of the pressures associated with development. Even if they survive in the short term, they may die before the new buildings are obsolete. Their subsequent removal can pose technical difficulties and be costly. Where the retention of large, mature or veteran trees is considered desirable, it may be most effective to conserve them by incorporating them into open spaces or large gardens, thereby allowing adequate space for their long term physical protection and maintenance.

6.3 Proximity of trees to structures

6.3.1 A realistic assessment of the probable impact of any proposed development on the trees and vice versa should take into account the characteristics and condition of the trees, with due allowance and space for their future growth and maintenance requirements.

6.3.2 The relationship of windows to trees which may obstruct light, should be taken into account. Excessive shading by trees should be avoided, particularly to rooms requiring light. This will vary with orientation and aspect of the building, proximity to the tree and the type of tree as foliage size and density varies with species (see also BRE Guides in the Bibliography).

6.3.3 Damage can occur to trees and structures by the continuous whipping of branches. Branch ends may have to be cut back repeatedly, possibly spoiling the shape of the tree. Trees should not be retained on the basis that their ultimate branch spread can be significantly controlled by periodic pruning, unless this is a desired management outcome (e.g. pollarded trees).

6.3.4 Large trees can cause apprehension to occupiers of nearby buildings especially during windy conditions.

6.3.5 Leaves of some species may cause problems, particularly in the autumn, by blocking gullies and gutters. Fruit can cause slippery patches and accumulation of honeydew may be damaging to surfaces and vehicles.

7 Arboricultural method statements (AMS) and the tree protection plan (TPP)

7.1 Once the layout proposals have been finalized a TPP should be prepared containing the following information:

a) trees selected for retention, clearly identified (e.g. by number) and marked on a plan with a continuous outline;

b) trees to be removed, also clearly identified (e.g. by number) and marked on a plan with a dashed outline;

c) the precise location for erection of protective barriers and any other relevant physical protection measures including ground protection (see Clause **5** and Clause **9**), to protect the RPA and marked as a construction exclusion zone on the plan (see **7.2**).

NOTE 1 While the root protection area may be plotted as a circle on the constraints plan, the position of the barrier and any ground protection should be shown on subsequent plans as a polygon representing the actual position of the protection. It is helpful during setting out, and for the purposes of enforcement if the plan is annotated with the dimensions of the exclusion zones.

d) design details of the proposed physical means of protection, indicated through drawings and/or descriptive text, including any development facilitation pruning;

e) areas of structural landscaping to be protected from construction operations to prevent the soil structure being damaged (see **6.2.2**).

f) all the details in a)–e) above should be incorporated into subsequent drawings and method statements used for design purposes or issued for use on site, to ensure that all interested parties are fully aware of the areas in which access and works may and may not take place.

NOTE 2 Attention is drawn to the CDM Regulations [7].

7.2 In order to avoid disturbance to the physical protection forming the construction exclusion zone once it is installed, it is essential to consider, make allowance for and plan all construction operations which will be undertaken in the vicinity of trees, in particular:

a) site construction access;

b) the intensity and nature of the construction activity;

c) contractors' car parking;

d) phasing of construction works;

e) the space needed for all foundation excavations and construction works;

f) the availability of special construction techniques (see Clause **11**);

g) the location and space needed for all service runs including foul and surface water drains, land drains, soakaways, gas, oil, water, electricity, telephone, television or other communication cables;

h) all changes in ground level, including the location of retaining walls, steps and making adequate allowance for foundations of such walls and backfillings;

i) space for cranes, plant, scaffolding and access during works;

j) space for site huts, temporary latrines (including their drainage) and other temporary structures;

k) the type and extent of landscape works which will be needed within the protected areas, and the effects these will have on the root system (for guidance see **11.9** for hard landscape and Clause **12** for soft landscape);

l) space for storing (whether temporary or long-term) materials, spoil and fuel and the mixing of cement and concrete.

m) the effects of slope on the movement of potentially harmful liquid spillages towards or into protected areas (see **9.4.2**).

8 Pre development tree work

8.1 General

Once a final layout for the development area has been approved, an arboriculturist should review the relationship of the development to the trees and prepare a schedule of tree works listing all the trees that require work by number, accompanied by a plan showing where each tree is located. The schedule should include all the trees to be removed to clear the main development area and those remaining that require remedial works. Remedial tree works should be based on what is required to establish acceptable levels of risk and management in the context of the proposed land use. The schedule of works should be accompanied by a detailed specification describing each work operation (see BS 3998).

NOTE Tree work is a specialist task that requires competent operatives, adequately insured. Guidance on the selection of an appropriate contractor can be obtained from the Arboricultural Association, which has a Directory of Approved Contractors (see Annex B for contact details).

8.2 Working within the RPA

8.2.1 Care should be taken to ensure during tree removal or remedial work that damage to the retained trees and/or disturbance to the RPA is avoided. Appropriate precautions should include dismantling techniques to reduce the risk of accidental damage and ground protection where excessive pedestrian movements or use of plant and machinery may lead to compaction.

8.2.2 Debris from tree work might be removed from site, chipped and left on site, or left on site in an unprocessed form as habitat depending on the site circumstances. Debris should not be burnt where it could damage the crowns of retained trees. Stumps within RPAs should not be dug or pulled out but should be ground out, if removal is required, to avoid adverse impact on retained trees. Consideration should be given to leaving standing stumps and debris as habitat for wildlife if the circumstances allow (see BS 3998[1)]).

9 The construction exclusion zone: barriers and ground protection

9.1 General

9.1.1 All trees which are being retained on site should be protected by barriers and or ground protection, as recommended in Clause **7**. Vertical barriers should be erected and ground protection installed before any materials or machinery are brought onto the site and before any demolition, development or stripping of soil commences. Areas of new or retained structure planting should be similarly protected, based on the extent of the soft landscaping as shown on the approved drawings. Once erected, barriers and ground protection should be regarded as sacrosanct, and should not be removed or altered without prior recommendation by an arboriculturist and approval of the local planning authority.

9.1.2 In the case of particularly vunerable trees or trees sited close to the construction access, the owner or developer should make arrangements for an arboriculturist to supervise necessary works and the erection of protection before the handover of land to the contractor.

9.1.3 Pre development tree work may be undertaken before the installation of tree protection, where required, with the agreement of the local planning authority (see Clause **8**).

9.2 Barriers

9.2.1 Barriers should be fit for the purpose of excluding construction activity and appropriate to the degree and proximity of work taking place around the retained tree(s). On all sites, special attention should be paid to ensuring that barriers remain rigid and complete.

9.2.2 In most cases, barriers should consist of a scaffold framework in accordance with Figure 2 comprising a vertical and horizontal framework, well braced to resist impacts, with vertical tubes spaced at a maximum interval of 3 m. Onto this, weldmesh panels should be securely fixed with wire or scaffold clamps. Weldmesh panels on rubber or concrete feet are not resistant to impact and should not be used.

NOTE The above is preferred because it is readily available, resistant to impact, can be re-used and enables inspection of the protected area.

9.2.3 It may be appropriate on some sites to use temporary site office buildings as components of the tree protection barriers.

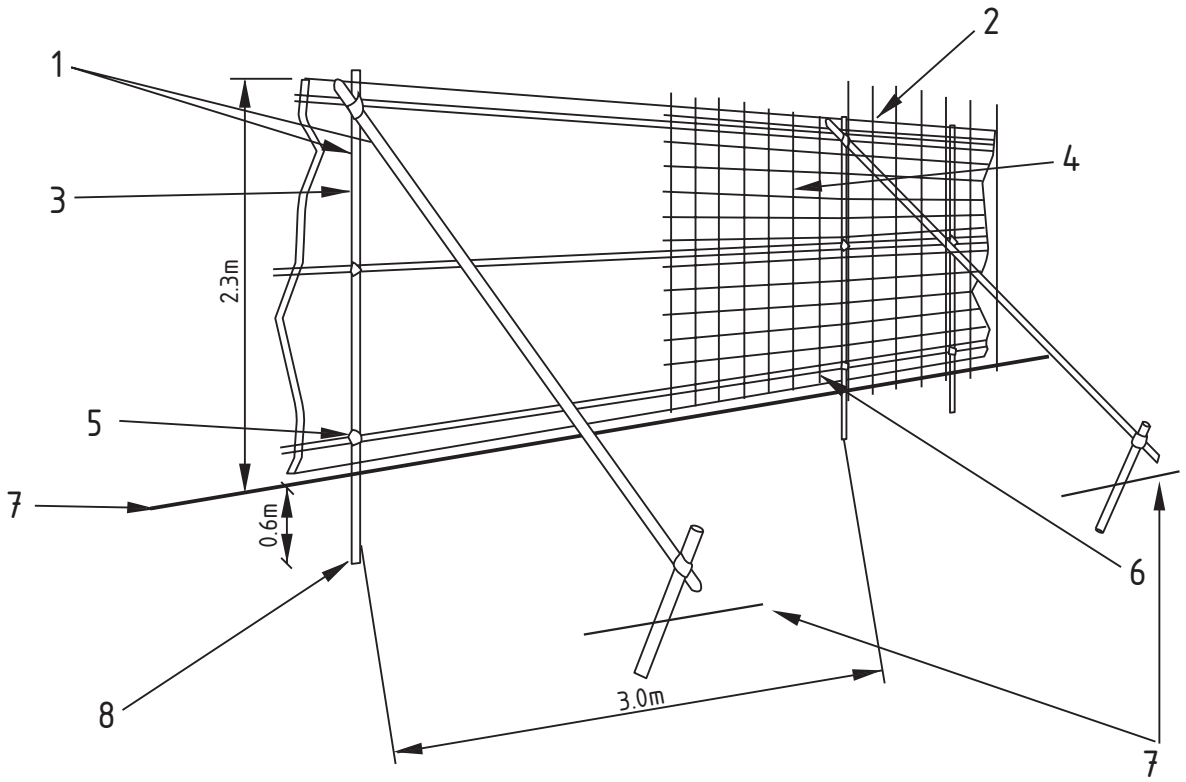
[1)] Revision in preparation.

9.3 Ground protection

9.3.1 Where it has been agreed during the design stage, and shown on the tree protection plan, that vehicular or pedestrian access for the construction operation may take place within the root protection area (RPA), the possible effects of construction activity should be addressed by a combination of barriers and ground protection. The position of the barrier may be shown within the RPA at the edge of the agreed working zone but the soil structure beyond the barrier to the edge of the RPA should be protected with ground protection.

9.3.2 For pedestrian movements within the RPA the installation of ground protection in the form of a single thickness of scaffold boards on top of a compressible layer laid onto a geotextile, or supported by scaffold, may be acceptable (see Figure 3).

9.3.3 For wheeled or tracked construction traffic movements within the RPA the ground protection should be designed by an engineer to accommodate the likely loading and may involve the use of proprietary systems or reinforced concrete slabs (see **11.8** and **11.9**).



1 Standard scaffold poles
2 Uprights to be driven into the ground
3 Panels secured to uprights with wire ties and where necessary standard scaffold clamps
4 Weldmesh wired to the uprights and horizontals
5 Standard clamps
6 Wire twisted and secured on inside face of fencing to avoid easy dismantling
7 Ground level
8 Approx. 0.6 m driven into the ground

Figure 2 — Protective barrier

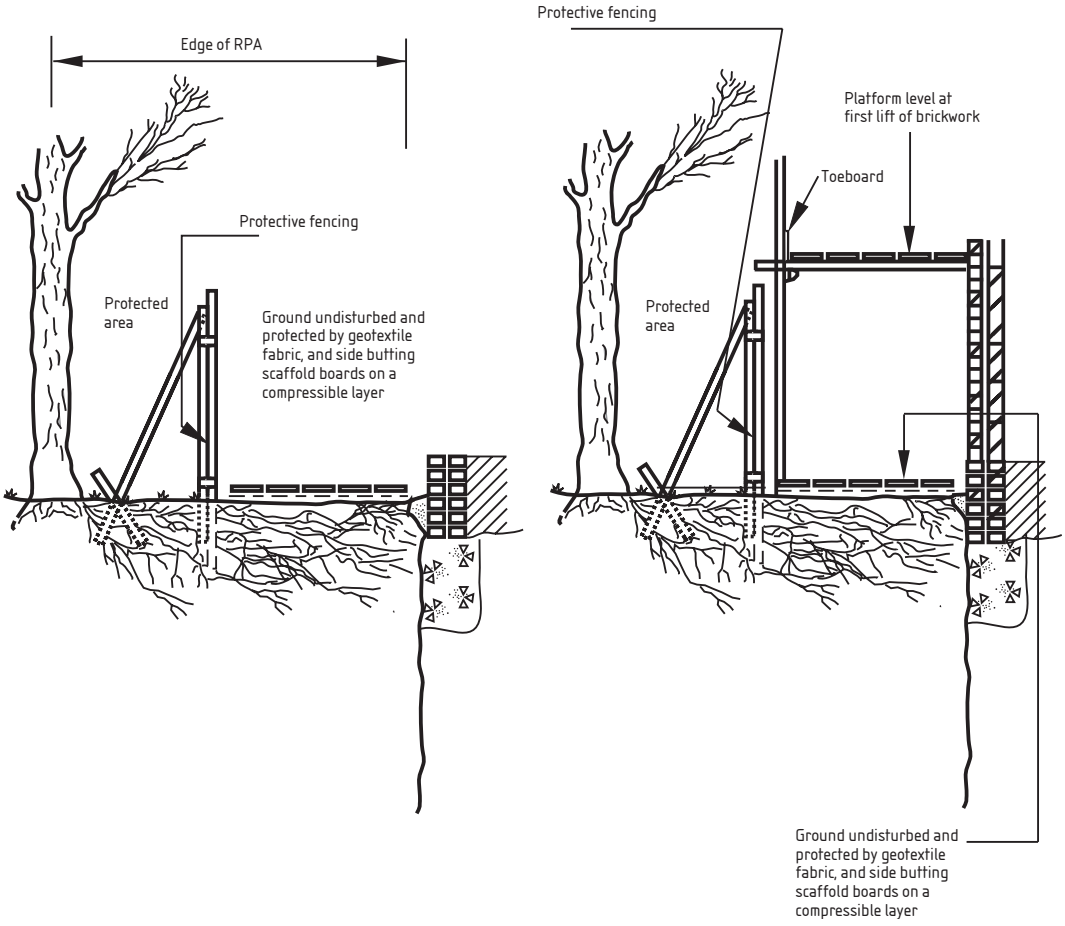


Figure 3 — Scaffolding within the RPA

9.4 Additional precautions outside the exclusion zone

9.4.1 Once the exclusion zone has been protected by barriers and/or ground protection, construction work can commence. All weather notices should be erected on the barrier with words such as:

"Construction exclusion zone — Keep out".

9.4.2 In addition the following should be addressed or avoided.

a) Care should be taken when planning site operations to ensure that wide or tall loads, or plant with booms, jibs and counterweights can operate without coming into contact with retained trees. Such contact can result in serious damage to them and might make their safe retention impossible. Consequently, any transit or traverse of plant in close proximity to trees should be conducted under the supervision of a banksman to ensure that adequate clearance from trees is maintained at all times. In some circumstances it may be impossible to maintain adequate clearance thus necessitating access facilitation pruning (see **11.2.1**).

b) Material which will contaminate the soil, e.g. concrete mixings, diesel oil and vehicle washings, should not be discharged within 10 m of the tree stem.

c) Fires should not be lit in a position where their flames can extend to within 5 m of foliage, branches of trunk. This will depend on the size of the fire and the wind direction.

d) Notice boards, telephone cables or other services should not be attached to any part of the tree.

9.4.3 It is essential that allowance should be made for the slope of the ground so that damaging materials such as concrete washings, mortar or diesel oil cannot run towards trees.

10 Avoiding damage to structures by trees

10.1 General

10.1.1 Buildings should be constructed to allow for future growth of planted or self-sown trees.

10.1.2 In some situations, trees and vegetation can adversely affect structures either by direct action (see **10.2**), or by indirect action (see **10.3**) causing shrinkage or swelling of a clay subsoil.

10.1.3 Even if no trees exist at the time of construction, they may be planted in the future or self-seeded. Consideration should be given to this possibility by having foundations in accordance with Table 3 which will allow for reasonable future vegetation, or to an engineered design (see NHBC Standards, Chapter 4.2 [14]).

10.2 Direct damage by trees to structures

10.2.1 Trees can cause direct damage to structures by:

a) the disruption of underground services and pipelines;

b) displacement, lifting or distorting;

c) the impact of branches with the superstructure;

d) structural failure of the tree.

The potential for direct damage should be taken into consideration throughout the design and construction process.

10.2.2 The growth of the base of the stem or of roots near the surface exerts relatively small forces. Whilst paving slabs or low boundary walls can be lifted or pushed aside easily, heavier or stronger structures are more likely to withstand these forces without damage, as the root distorts around the obstruction before damage occurs. The greatest risk of direct damage occurs close to the tree from the incremental growth of the main stem and secondary thickening of the roots, and diminishes rapidly with distance.

10.2.3 New tree planting should be kept at distances from structures of at least those in Table 3.

10.2.4 In the case of established trees where construction work is to take place near to the main stem and roots, the following precautions should be taken to allow for future tree growth in order to protect the structure:

a) foundations should be reinforced to resist lateral thrust; or

b) walls or structural slabs should bridge over roots allowing sufficient clearance for secondary thickening or be designed to distort without cracking; or

c) pavings and other surfaces should be laid on a flexible base to allow movement and to facilitate relaying if distortion becomes excessive.

10.2.5 Water leaking from damaged drains, sewers or water mains encourages localized root growth. Roots are then likely to enter a drain or sewer through the defect and proliferate, causing blockage and an enlarging of the initial defect. Provided they are further from trees than distances stipulated in Table 3, intact drains are not likely to suffer direct damage and will not attract roots. Damage to drains and sewers can be avoided by the following:

a) re-routeing services to conform to Table 3;

b) ensuring watertight joints;

c) in clay soils, use of flexible materials and/or joints to accommodate movement;

d) not using perforated land drains near trees.

10.2.6 Allowance should be made for the swaying of stem and branches during storm conditions. Branches which are liable to strike the structure should be pruned back to a suitable branching point (see BS 3998). Trees in a condition that renders them liable to collapse should not be retained near structures (see category R in Table 1).

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