

ARBORICULTURAL METHOD STATEMENT FOR DISCHARGE OF CONDITION 10

LAND AT WOOD LANE CADEBY

Prepared for
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c/o Hayward Architects Ltd
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Prepared by
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4th April 2012

1.0 INTRODUCTION

1.1 Planning permission was granted for the erection of a detached dwelling and garage, and the creation of a vehicular access, on land adjacent at Wood Lane Cadeby. The application was granted on 23rd August 2011 by Hinckley & Bosworth Borough Council, (reference: 11/00523), which was a revised scheme. The planning permission was granted subject to a total of twelve conditions. Condition number 10 requires that a *"method statement outlining the method of working, tree protection plan and tree surgery specifications shall be submitted to and approved in writing by the Local Planning Authority. All works to the trees hereby approved shall be carried out in accordance with the approved details unless otherwise agreed in writing by the Local Planning Authority."* This document sets out the tree protection and working methods that will be adopted to successfully retain trees on and adjacent to the site, as well as reasons for removal of an additional tree originally shown for retention.

1.2 An arboricultural report was originally submitted in August 2007, to assist with an earlier planning application. These data were revised and reviewed in 2008 & 2011. This method statement should therefore be read in conjunction with the previous arboricultural report, submitted at the time of both of the previous planning applications.

1.3 The details for the construction of the new access from Wood Lane, the visibility splay and drive leading to the garage, have been prepared following discussions between Leicestershire Highways Forestry Section, the client, the project architect and arboriculturist, to determine the most suitable construction method, in order to minimise disturbance of the ground where levels are to remain as close as possible to those existing. Any excavations required will be undertaken in such a way that the maximum quantity of roots can remain intact within the constraints of the planning permission.

1.4 The creation of the access, the gradients required to meet the Leicestershire Highways standards, coupled with their published guidance for the extent of the bound surfacing, has lead to a review of the planning permission as granted. The removal of the horse chestnut, T2 will be necessary, to facilitate the creation of the access in the approved location on to Wood Lane. This tree is owned and managed by Leicestershire Highways, whose Forestry Officer, Mr P Kenyon, has been consulted. The reasons for the removal of this specimen are set out in Section 2 below. Because the site is located within the Cadeby Conservation Area, replacement planting proposals have been agreed with Leicestershire Highways, in mitigation for the removal of this tree (T2).

2.0 THE APPROVED SCHEME:

2.1 Access from Wood Lane

2.1.1 The approved plans show two of the three Horse chestnut trees adjacent to the Wood Lane frontage as retained. The largest specimen (T1), adjacent to Dunvegan has been agreed for removal from the outset, because of its poor condition. It was made clear at the time the planning application was submitted that the construction of an access in accordance with the gradients required to meet the Leicestershire Highways standards of no greater than a 1:10 gradient from the highway into the site, would be incompatible with the successful retention of the middle of the three horse chestnut trees, scheduled as T2 in the arboricultural report. Hinckley & Bosworth Borough Council's Arboricultural Officer commented that "*removal and replacement would be the better option".* However, at the time planning permission was granted, the Council's Conservation Officer requested that T2 be retained.

2.1.2 On further review, it is clear that the retention of this tree remains incompatible with the construction of the access because the existing levels 3 metres inside the site from Wood Lane are approximately 1 metre above the level of the road. This would lead to a requirement to reduce the site levels at this point by approximately 700mm to achieve the 1:10 gradient, within 4 metres of the main stem of the tree. The excavations would lead to extensive root damage to the extent that the stability of the tree would be compromised.

2.1.3 Two of the three Horse chestnut trees (T2 & T3), are growing within the highway verge and are managed by Leicestershire Highways. A meeting took place on 28th March 2012, with Peter Kenyon from the Leicestershire Highways Forestry Team to discuss the tree. Mr Kenyon agreed that the retention of the tree would be incompatible with the creation of the access in its approved location and stated that the County would not object to the removal of the tree by the developer, subject to the provision of two new trees on either side of the new site entrance in mitigation for the loss of the two horse chestnuts (T1 & T2).

2.1.4 It should be noted that T2 & T3 are managed by Leicestershire Highways, as they are within the highway verge. T3 is to be retained and protected for the duration of the construction works. T1 is the tree closest to Dunvegan and is within the site. This tree is the responsibility of the developer, who has agreed to provide a replacement in mitigation for the tree's removal.

2.1.5 The replacement trees, which will be planted in mitigation for the removal of the two Horse chestnuts (T1 & T2), will be 1no. Swedish birch *(Betula pendula 'Dalecarlica')* and 1no. Turkish hazel *(Corylus collurna).* The trees will be supplied and planted by the developer and will be container grown specimens with a minimum girth of 10/12cm at the time of planting.

2.2 The Driveway

2.2.1 The majority of the drive lies within the root protection area (RPA) of the retained Horse chestnut adjacent to the Wood Lane frontage (T3), or it passes close to the off-site beech (T4), growing on the boundary with Church Cottage. The majority of drive area will therefore need to be constructed in accordance with a 'no-dig' construction specification.

2.2.2 The proposed finished level of the driveway beneath T3 lies at approximately a metre above Wood Lane, enabling this to be built utilising a cellular confinement system as the sub-base for the drive construction, where this lies within the RPA of the retained trees. The gradient from Wood Lane into the site for the first 4 metres will be constructed using traditional construction methods because it will be necessary to reduce the levels to create the required gradient and thus the 'no-dig' method is not practical.

2.2.3 The area of driveway shown hatched in blue on the drawing at Appendix 1 illustrates the extent of specialist construction. This will be built using a cellular confinement system for the base course, adopting a 'no-dig' construction method where this lies inside the RPAs of the two retained trees (T3 & T4).

2.2.4 The preferred cellular confinement product is *Cellweb*, manufactured by *Geosynthetics Ltd.* The use of this product and its correct installation will ensure that any potential compaction of the subsoil, which can lead to oxygen depletion in the root zone that may be affected by the drive construction will be minimized.

2.2.5 To ensure that the root systems of the two retained trees are appropriately protected during and after construction, the following construction method is to be adopted. This is based on general guidance set out in Arboricultural Practice Note APN12 "Through the Trees to Development" 2007 (see Appendix 2). In this instance, it is recommended that a cellular confinement system as shown in figure 6 of this document is utilised. This specification requires that the access be constructed on the existing ground level and extreme care will be required to ensure that the ground is not compacted and damage does not occur to the trees' roots whilst the works are being undertaken.

2.2.6 It is envisaged that following construction, only domestic vehicles will use the driveway and access the garage. There will be no requirement for larger or heavy vehicles to enter the site. The ground investigation report indicates that the ground conditions are primarily sandy gravel with a relatively low clay content and so a 50mm - 100mm thickness of *Cellweb* may suffice. This should however be confirmed by an engineer in consultation with the product manufacturers.

2.2.7 **Timing of Construction Operations:** The construction of the no-dig area shall only be undertaken when the ground surface is firm and dry and works shall be temporarily suspended if the ground becomes saturated.

2.2.8 **Site Supervision:** Installation of this section of the drive will take place under the direct supervision of the project arboricultural consultant, who will supervise the critical phases of the construction of the no-dig section. These phases being:

- To agree the setting out of the location of the protective fencing and to check that it has been properly erected before construction works commence (Phases 1 & 2)
- Removal of surface vegetation following herbicide application where the 'no-dig' part of the access drive is to be constructed in accordance with this method statement
- Levelling of existing ground by the addition of sharp sand where required
- The installation of the *Cellweb* and granular fill shall be supervised either by the arboricultural consultant or by the suppliers of the cellular confinement system as part of their supply service

2.2.9 **Use of Geotextile -** The geotextile acts as a separation layer preventing the mixing of formation fines with the granular infill (see APN 12 at appendix 2).

2.3 No-dig method

Remove surface vegetation	By the application of a *Glyphosate* based herbicide, which will not harm the trees' root systems. Once the vegetation has died off, this will be removed manually
Level the drive	Place sufficient depth of sharp sand to create a level construction surface, filling indentations and minor alterations of levels. The area of special construction will be built on the level surface
Place geotextile separation / filtration layer	Lay a non-woven geotextile Type F4M or similar, over the prepared sub-grade. Overlap dry joints by 300mm
Cellular confinement system	Expand the 50mm or 100mm deep *Cellweb* over the geotextile and anchor open during infilling with a no fines angular fill of 20 – 40mm within open cell

Edge restraint	A treated timber edging 50mm x 225mm will be required to confine the *Cellweb* adjacent to the edges of the turning head and will be restrained with pegs as shown on the detail at Appendix 3
Final surface	The specification for the final wearing surface will be engineer designed and specified by others

3.0 PROTECTIVE FENCING

3.1 Prior to any site clearance or construction works commencing on site, protective fencing, to the specification shown in Figure 2 of BS 5837:2005 (illustrated on the drawing at Appendix 1) shall be erected in the location indicated for Phase 1 Fencing. This will be maintained for the duration of the main construction works for the construction of the house and garage, accessing the site from the land to the south and east via Church Lane. The protected areas will remain fenced and undisturbed until such time as the driveway and access from Wood Lane is constructed.

3.2 The fencing shall remain in place until all of the main construction works and any potentially damaging landscaping operations have been completed, or written agreement has been obtained from Hinckley & Bosworth Borough Council to do otherwise. The site manager will be responsible for inspecting the protective fencing on a daily basis. Any damage to the fencing or breaches of the fenced area will be rectified immediately.

3.3 When the access from Wood Lane and is to be constructed and the 'no-dig' specification driveway installed, the protective fencing shall be relocated to the 'Phase 2 Fencing' location illustrated on the plan at Appendix 1.

4.0 GENERAL PRECAUTIONS

4.1 No diesel oil, bitumen, cement or other material potentially injurious to the trees should be stacked or discharged within 10 metres of the retained tree or where it could leach into their rooting zones and no cement mixing should take place within this distance.

4.2 Extreme care should be exercised if cranes or other lifting equipment are to be used in proximity to the retained tree, to avoid damage being caused by the boom or the material being lifted. All such lifting or unloading operations should be supervised by a suitably experienced banksman.

4.3 If at any time it would appear that a construction operation may cause damage to the retained trees' roots or rooting environment, works shall be temporarily halted and the problem brought to the attention of the site manager who will seek the advice of the appointed arboricultural consultant.

5.0 TREE WORK

5.1 Recommendations have previously been made for the crown reduction of the Horse chestnut (T3), where this overhangs Wood Lane, the adjacent Church Cottage and the site. These works should be undertaken following the severance and removal of ivy and a review of the tree undertaken to determine the condition of the root collar, stem and base of the crown.

5.2 The lower branches from the off-site beech (T4) should be pruned back where they overhang the approach to the new garage to provide a minimum of 3 metres clearance over the new drive.

5.3 All works shall be undertaken in accordance with BS 3998: 2010 – British Standard for Tree Work.

6.0 SUMMARY

6.1 Care has been taken in the preparation of the proposals for this project and following points should be acknowledged when discharging planning condition number 10:

- Despite attempts to retain two of three Horse chestnut trees, it has become apparent that the retention of T2 is incompatible with the approved plans because of the requirements to achieve a 1:10 gradient for the site access. Discussions have therefore taken place with Leicestershire Highways to agree a way forward, which includes for the removal of the tree and mitigation planting

- The drive lies within the root protection area of the retained Horse chestnut and beech trees (T3 & T4), and all works within these areas will be constructed adopting a 'no-dig' construction specification

- All works will be undertaken either under the direct supervision of the arboricultural consultant or in accordance with this method statement where works are on the edge of the root protection area

Lesley J Adams
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APPENDIX 1

WOOD LANE

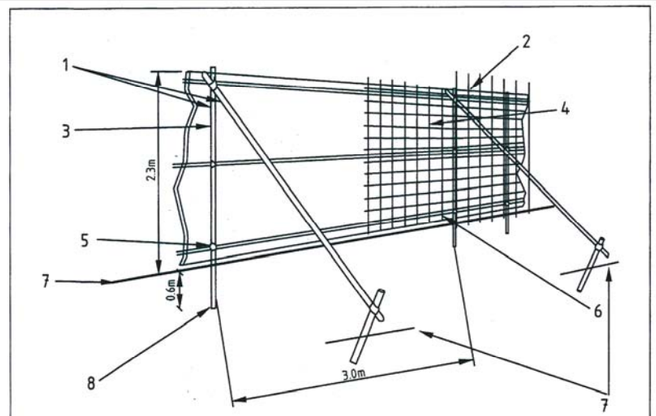
CADEBY

ARBORICULTURAL METHOD STATEMENT PLAN

T1 & T2 felled. To be replaced by:
1 no. Swedish birch (10/12cm girth container grown)
1 no. Turkish hazel (10/12cm girth container grown)

Yew hedge 2.3mh
Stone RW 0.24mh
Stone RW 0.36mh
Brick pillar
Wooden paling 1.2mh
Np RS
Footpath (tarmac)
Kerb
Gully
MH (F) CL 125.61 IL 122.97
150
WOOD LANE (tarmac)
125.05
125.075
MH (F) CL 125.31 IL 122.78
T3
T2
T1
T1 to be removed
Paving blocks
SC
Stone RW
Wooden post & rail fence 0.95mh
Brick RW 0.2
Church Cottage
126.400
126.200
125.750
126.050
FFL 126.200
T4
root protection zones
see tree report
Church Cottage
INDICATIVE
Cypress hedge 2.5mh
approved house and garage
(ref:10/00646/FUL)
FFL 126.175
plot 1
existi
see a
new 1800mm high
close-boarded fence
125.300

BS5837:2005 FIGURE 2 - PROTECTIVE BARRIER



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

KEY

- Phase 1 fencing
- Phase 1 fencing
- Root protection area (RPA) for T3 & T4
- 'No dig' drive specification
- This minimal encroachment in the RPA for T3 will not require specialist construction

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Site: LAND AT WOOD LANE, CADEBY

Title: ARBORICULTURAL METHOD STATEMENT PLAN

Client: M & L BUILDERS (ATHERSTONE) LTD / HAYWARD ARCHITECTS LTD

Drawing No: M&L/WLC/02

Scale: 1:200 @ A3 | Date: APRIL 2012

APPENDIX 2

WOOD LANE

CADEBY

APN 12

THROUGH THE TREES TO DEVELOMENT

Trees in focus

APN 12

Arboricultural Practice Notes

Through the Trees to Development

Derek Patch and Ben Holding

Arboricultural Advisory and Information Service

Summary

The majority of tree roots grow in the upper metre of soil and they may spread outwards in any direction a distance equal to the tree's height. Any disturbance of the ground within the root spread of a tree can damage its roots and may severely injure the tree. Damage to roots will interrupt the supply of water necessary to keep the tree alive and may cause decline in vigour, dieback or even death of the tree.The tree may also be made unstable and so pose an unacceptable threat to the safety of people and property. Development of a site, including construction of access routes, driveways and parking areas can result in substantial root severance of trees. Techniques for the construction of access drives, which may avoid or lessen the damage caused to trees, are described.

This note embraces the principles first published by The Tree Advice Trust as "Driveways Close to Trees" (Aboricutural Practice Note No. 1[1]) and reviews where the principles may be applied in practice.

Trees: A Cause of Conflict

Development of a site is sometimes hampered or prevented because of the presence of trees. Local authorities and residents may wish to see trees 'preserved' whilst developers seek permission to build close to them - often ignorant about the damage this may cause to trees. Even developments such as access drives and parking areas can threaten existing nearby trees.

Traditional driveway construction (excavation and backfilling with a compactable load-bearing sub-base material) can seriously damage tree roots. Such damage occurs because of a lack of understanding that roots mainly grow outwards from a tree's trunk, near to the soil surface, rather than downwards (Dobson 1995). Where there is a significant risk of damage to trees by root severance, or changes in soil conditions during construction, local planning authorities may sometimes refuse permission for installation of an access driveway or parking area close to trees - especially if the trees are subjects of Tree Preservation Orders.



Figure 1.
Incorrect representation of a tree's root system.

However, if the potential for damage to the tree's root system (e.g. by severance or soil compaction) can be avoided during construction, development may be more easily accepted. A technique is described below which should reduce the risk of significant damage to tree roots while enabling access and parking for light vehicles to be constructed close to trees.

Where Do Tree Roots Grow?

Survival of a tree depends on its roots being able to absorb enough water from the soil to sustain the foliage (an estimated 1,000 litres per day in summer for a fully grown forest tree in a rural area) and on developing a strong root system capable of keeping the tree upright through autumn and winter gales. To achieve this the tree's roots must exploit a very large volume of soil. However, the assumption that these requirements are met by a system of roots growing predominantly downwards (Figure 1), and that anchoring roots are very thick and descend into the soil for many metres (like the base of a lamp post) is incorrect. In reality tree roots:

[1] Driveways Close to Trees, Arboricultural Practice Note No. 1 is withdrawn and superceded by this wider text.

- grow in any direction more or less parallel with the soil surface rather than vertically (Figure 2). This is also true for trees growing on sloping land.
- are usually relatively shallow - most of a tree's roots are in the upper metre of soil.
- usually radiate outwards from a tree for a distance equivalent to at least the tree's height (which for a mature tree may be 20 m or more).
- can be 30 cm or more in diameter at the base of the trunk.
- sub-divide and taper rapidly as they extend out from the trunk.
- are only 2-3 cm in diameter, and often much less at 3-4 m distance from the trunk.

The small woody roots (those less than 3 cm diameter) taper very little but they may spread out for long distances. Smaller, non-woody roots (sometimes described as white, feeder, fibrous, fragile or absorbing roots) grow outwards and usually upwards from the woody roots and subdivide to exploit the better aerated surface soil. Although generally short lived they (and the fungi associated with them - called mycorrizas) are the principal absorbers of moisture and nutrients.

Most roots (both thick and fine) are situated close to the soil surface, forming a thin layer less than 1m deep, but some small roots (usually only a few mm in diameter) may reach 2 m or more deep.

Roots and the Soil

Roots are living and, like all plants and animals, must have oxygen if they are to survive. Without oxygen roots are unable to function properly or grow, and when they are starved of oxygen for prolonged periods, they die.

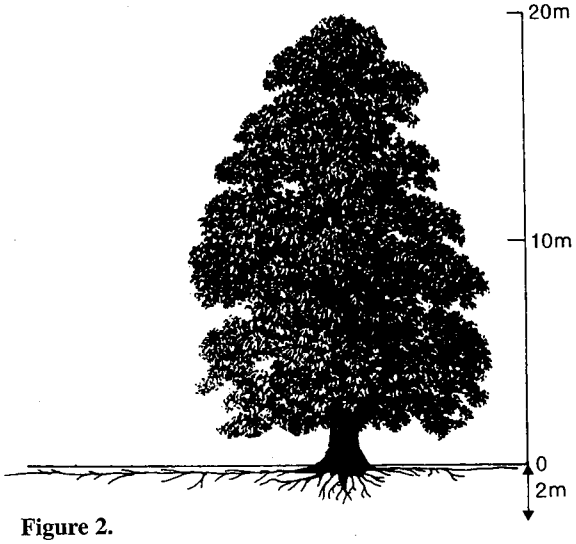


Figure 2.
Trees have a relatively shallow but wide spreading root system.

Both oxygen and water are held in the pores between the soil particles. Where the pores are large (e.g. in coarse or sandy soils) the soil will generally be freely draining and well-aerated, but where the pores are small (e.g. in heavy clays or soils which have been compacted) they may be full of water and have a poor supply of oxygen.

Most trees that have been growing undisturbed on a site for many years will have developed an extensive root system with the roots growing where the soil conditions are most favourable. There will be a balance between the development of the crown (which demands water) and the roots (which supply it). Any sudden alteration of the soil conditions within the tree's rooting area (a circle of radius equal to the tree's height) will therefore upset this balance. For example, the single passage of a machine will 'squeeze' the soil closing up the pores (causing compaction - especially in the upper levels) and so reduce the amount of oxygen available to roots which prevents them from growing through the soil. With each additional machinery movement the compaction increases and so do the problems for the tree and its roots.

Placing soil or other materials over the root system of a tree will impede air movement into and out of the soil around the roots and consequently reduce the availability of oxygen to the roots. The effect on the tree is usually progressive shoot and branch dieback until a new balance has been reached between the reduced capacity of the damaged root system to absorb water and the demands of the leaves. If damage is progressive or so severe that such a balance cannot be achieved, the tree will ultimately die.

Excavations - **even stripping the topsoil** - within the rooting area will sever roots. The closer the excavation is to the trunk of the tree the larger will be the roots lost and the greater the significance for the health and stability of the tree. Once the excavation is a metre deep virtually all of the roots growing into the excavated area will have been severed. The tree may then either be unable to absorb sufficient water to sustain the foliage and dieback will occur, or anchorage will be so reduced that the tree is unsafe and has to be severely pruned or even felled for safety.

Soil compaction, excavations and soil level increases will all damage roots and the closer to the trunk they occur the greater the damage inflicted on the tree. Nevertheless, healthy trees are generally able to withstand the loss of some roots (a maximum of about 20% of the rooting area, Helliwell and Fordham (1992)) without noticeable adverse effects.

Development Near Trees

British Standard BS 5837:2005 *Trees in Relation to Construction – Recommendations* recommends that on construction sites an area around a tree should be left undisturbed (the Root Protection Area) so that unacceptable damage to the root system is avoided. In the British Standard the Root Protection Area is calculated as

the equivalent of a circle about 12x the diameter of the tree's trunk (measured at 1.5m above ground level). The distance from the trunk extending to the branch spread, or half the tree's height, whichever is the greater (Figure 3) is a useful indicator of the typical Root Protection Area for a given tree.

The Root Protection Area is an area of protected ground around a tree within which any activity that could damage roots should be prohibited without the prior agreement of an aboriculturist.

However, if the principles and guidelines set out below are followed, installation of access driveways and parking for light vehicles within the Root Protection Area may, in many situations, be possible without causing significant, permanent damage to trees. Nevertheless, expert arboricultural advice should be sought to determine whether the tree and the site conditions lend themselves to the principles described in this Note. Any assessment of a site should include consideration of the health and overall condition of the tree(s). That is because old and declining trees may be vulnerable to sudden changes in the site conditions and so they may warrant a larger area than the minimum recommended in the British Standard.

Engineering Needs

Driveways, footpaths and car parking areas must be built on a firm, stable base. Engineers usually achieve this by excavating the soil to a depth of about 0.5 m, compacting the base if necessary, and backfilling with an inert material that can be compacted to form a stable platform. This usually involves progressive placement of layers of inert material with each being compacted by repeated passes of a powered roller or whacker plate. Each pass of a machine creates increasing compaction at depth in the soil. The edges of the excavation act as the supporting formation and kerbs or other edgings may be used to retain the surface material.

Any such excavations or soil stripping will sever roots and should be avoided within the Root Protection Area.

Compacting the base of an excavation can change the bulk density of the subsoil creating conditions unsuitable for the survival of any roots, particularly the water absorbing fine roots, contained in that volume. Placement and particularly compaction of load bearing construction materials will contribute to this creation of conditions unsuitable for root survival

On many sites it is possible to construct an adequately supported access driveway suitable for limited usage by light vehicles while retaining healthy, stable trees, by adoption of three principals particularly when construction is within the Root Protection Area as determined in consultation with an arboriculturist.

Where the finished structure will be adopted by the Highway Authority a more robust specification may be required. Provided the same principles are embraced construction across the root systems of trees should still be feasible.

Protection and Construction

For tree roots to be retained undamaged there must be *no excavation, no soil stripping* and *no grading of the site within the Root Protection Area* - in other words, **NO DIGGING**. This means that construction will have to be above the existing ground level.

Passage of vehicles across an unprotected soil surface must also be avoided, particularly where the soil is wet, as this will cause breakage of surface roots, soil compaction and consequently reduced soil aeration. These problems are heightened on clay soils. Most vulnerable to soil compaction are the fine white roots (those roots that are generally difficult to find when soil is examined) essential for water absorption. Surviving roots may not be able to grow through the compacted soil.

To reiterate there must be **NO COMPACTION** of the soil.

Where trees are to be retained on a site it is essential, therefore, that all but the immediate area of the development is protected from access and construction operations by fencing as recommended in BS 5837.

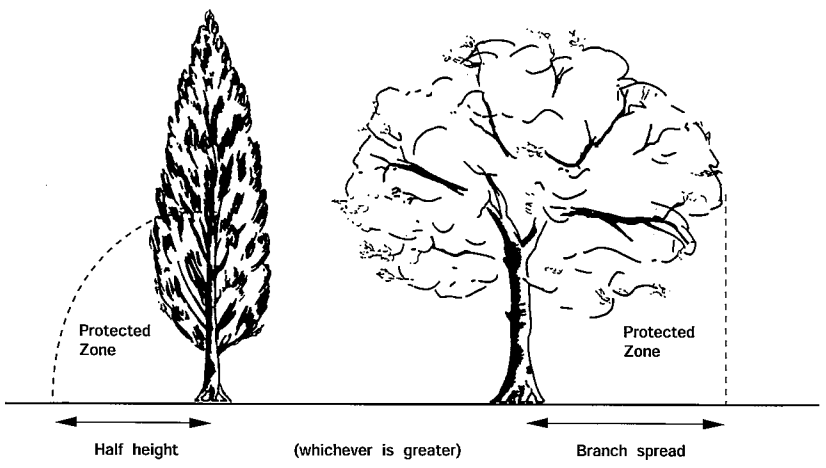


Figure 3.
Distance from a tree which constitutes the zone in which roots should be protected - i.e. no digging.

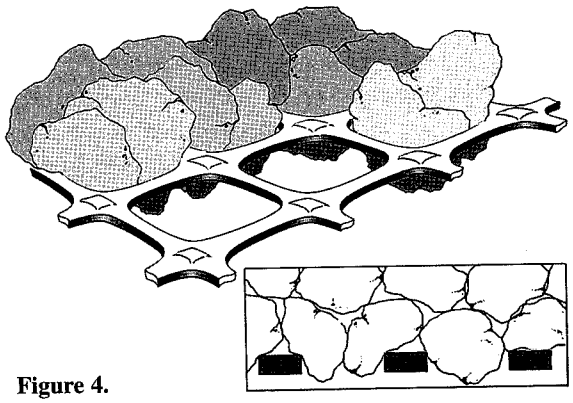


Figure 4.
The mechanism of interlock between aggregate and geogrid.

No-Dig Construction

Successful retention of trees, even when adopting a no-dig method, depends upon the condition (health and vigour) of the tree(s), which should be assessed by a qualified arboriculturist, and on adherence to three simple rules within the Root Protection Area:

- roots must not be severed, cut or broken – **no digging**
- ground levels must not be changed - **no digging, no soil level raising**
- **soil must not be compacted – no tracking of vehicles**
- oxygen must be able to diffuse into the soil beneath the engineered surface – **no tracking of vehicles**

Meeting the Engineering Needs

Damage to trees can be avoided only if the construction embraces the above simple principles and, within the fenced Root Protection Area, is no more than 5m wide.

Construction should incorporate two main components:

- a synthetic load spreading material
- a no-fines aggregate sub-base

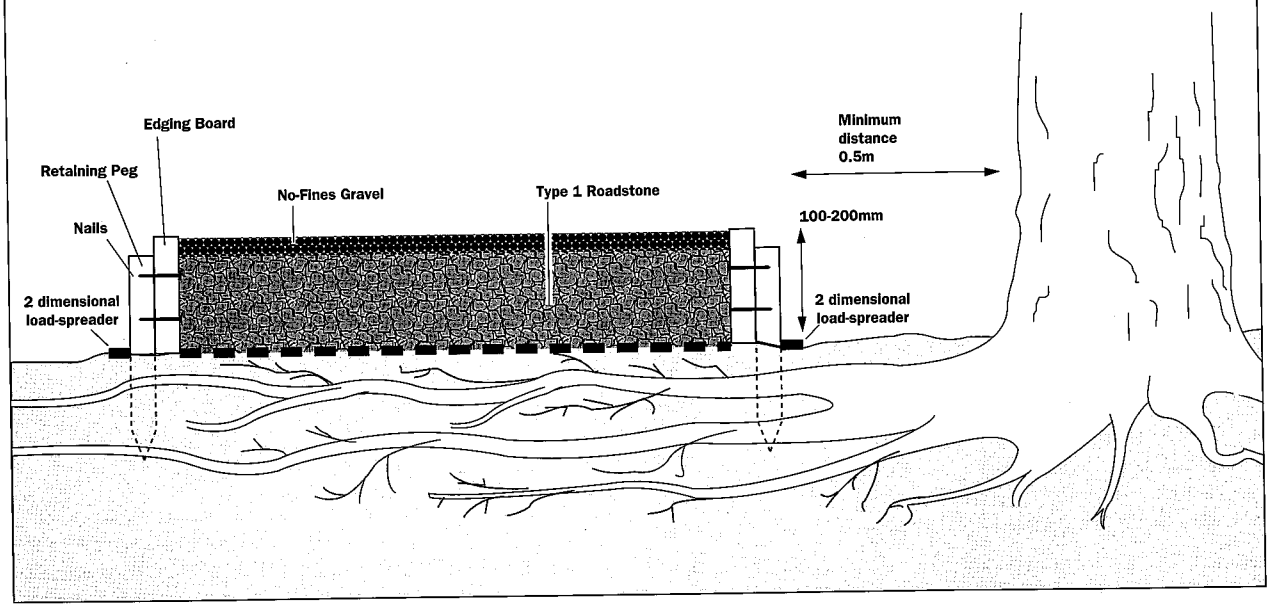
Note: a geotextile, which is usually used to prevent layers of different mineral materials mixing while allowing water to pass through, is not designed to be load bearing.

'Load spreading' materials, are synthetic grids/webs designed to support roads on soft ground by distributing the load of a wheel over a larger area than would normally occur. They may be 2- or 3-dimensional.

When placed on a 2-dimensional grid, appropriate, no-fines granular sub-base material penetrates the mesh, but is unable to pass through it, forming a positive interlock (Figure 4). This interlock between aggregate and grid provides a reinforced platform and efficient load spread into the underlying ground over a wider area than the footprint of the wheel on the surface. A suitable geogrid/aggregate combination constructed with the grid under tension should prevent rutting of the ground beneath the construction (Figure 5).

The 3-dimensional load spreading products (Cellular Confinement System) create cells into which the sub-base material is placed (Figure 6). Such a construction does not support the sub-base material, it confines the material in discrete cells. Manufacturers recommended, therefore, that a geotextile (see note above) is placed between the ground

Figure 5. Diagram of a 'no-dig' method for constructing access drives and parking near to trees in order to minimise damage to tree roots. *(Not to scale)*



and the load spreader to prevent the cell-contained mineral material being pressed down into the underlying soil.

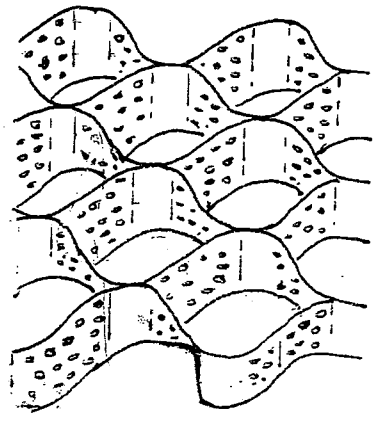


Figure 6.
3-dimensional load-spreader

A no-dig construction, that is a construction above ground level, will need to be contained to prevent outward creep under the weight of vehicles. This may be achieved with an edging support provided its construction does not involve excavation. A suitable material may be long-life timbers pinned through the load-spreader into the underlying soil. This could add strength to the structure because the pressure of vehicles forcing the sub-base downwards and outwards will tend to increase the tension on the grid and any tendency to rutting.

Note: some manufacturers specify that their product should be placed in a 100mm or greater depth of formation (i.e. excavation). It is important that before such a construction is adopted the agreement of an arboriculturist who has considered the circumstances of the tree's health and evaluated the site conditions, should be obtained. Failure to do so could result in breach of a Tree Preservation Order and Conservation Area legislation because roots will inevitably be damaged by an excavation of as little as 100mm.

The granular sub-base material should have a no 'fines' content which means that even when it is compacted it should be freely draining and will allow oxygen to diffuse into, and damaging gases (e.g. carbon dioxide and methane) out of the soil.

For site-specific prescriptions and materials specifications advice should be sought from a qualified geotechnical or civil engineer who should work in consultation with an arboriculturist.

Putting the Principles into Practice

Is the site suitable for a no-dig construction? (see next section)

Construction should ideally be undertaken in dry weather between May and October when the ground is likely to be driest and least prone to damaging compaction.

There must be a method of working that does not require movement of machinery or heavy plant within the branch spread of the tree before the ground is protected by a load spreader and the sub-base. Then the movements must be only along the construction.

For example when making a new access into a site construction should commence at the entrance to the site and 'roll out' the driveway in front of the machinery which always remains over the sub-base.

Ground vegetation should be killed using a translocated herbicide such as glyphosate[2]. (This may be most appropriately done in consultation with an experienced arboriculturist to ensure that the chemical and application method do not result in damage to retained trees.) After allowing time for the chemical to be absorbed and kill the plants, including their roots, gather up the dead organic material - this will prevent the build up of anaerobic conditions beneath the construction which might otherwise occur as dead vegetation decomposes.

Carefully remove major protrusions such as rocks.

Remove tree or shrub stumps (stumps should be ground out rather than excavated to minimise soil disturbance).

Fill major hollows with clean sharp sand – **DO NOT GRADE-OFF HIGH SPOTS**.

If necessary, for example when using a three dimensional cellular confinement product as a load spreader, a geotextile should be spread over the area of the driveway or car park.

With a two dimensional load spreading product into which the no-fines sub-base stone forms a lock a geotextile may be used but it is not essential.

Lay the synthetic load spreader directly onto the levelled ground or the geotextile as appropriate.

Secure the synthetic load spreader under tension using long pins driven into the ground through the grid.

Note: Before driving pins into the ground check for underground services that could be damaged.

Construct an edging which is secured through the load spreader so that pressure on the running surface will force the edging outwards and so increase the tension on the load spreader.

Cover the load spreader with a minimum of 100 mm of no-fines aggregate. This should not be tipped straight onto the synthetic material, but should be placed at one end and then pushed onto the load spreader between the retaining edges so that machinery is supported by the spread sub-base material rather than directly on the load-spreader and not on the ground either side of it.

Compact the sub-base to ensure binding with the load spreader and to minimise future rutting.

[2] When selecting a herbicide care must be taken to select a product which does not damage the roots of desirable vegetation that may extend into the treated area. Always read the product label before use.

A further geotextile may be placed over the sub-base to prevent dry bedding materials or surfacings merging with the sub-base.

Place the final surface. In the main it is likely that this will consist of gravel or tarmacadam, although paving slabs and brick paviours may be acceptable provided they are dry bedded on the sub-base and the joints are not sealed with grout, to allow for infiltration of water and gaseous diffusion[3].

Where a mass concrete, or impervious surface material is required the specification for an adoptable road (see below) should be used.

Sites are not all the Same!

The principles detailed above, if applied sensibly, should permit access to be constructed across the root system of a healthy tree. That is where the construction passes through the Root Protected Area retained around a tree as recommended by British Standard BS 5837:2005 *Trees in relation to construction - Recommendations.*

Why the 'sensibly'? No two sites are the same, in fact some are totally unsuitable for a no-dig construction and it may be necessary to admit that access to the site cannot be achieved if certain trees are so important/valuable that their retention is essential. For example, where trees grow on an old hedge bank excavation to cut through the bank may be unavoidable and so an unacceptable proportion of the root system would be severed. In contrast ditches that can be filled/piped/bridged (Figure 7) should be less problematic.

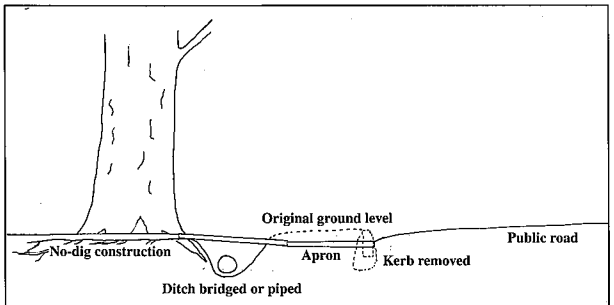


Figure 7. No-dig construction and a ditch.

When planning a driveway it is important to consider the ground levels on site and to relate them to the fixed level on the public thoroughfare into which the drive must connect and be tied. Where a roadside verge within the root protection area around a tree cannot be crossed without excavations then a different access point may be needed if the tree is deemed to be of very significant value to the amenities of the area.

Highway Authorities generally seek an 'apron' (upto 4m long), with a shallow or no gradient and a sealed surface at the entrance to a site where the drive joins the highway. This is to reduce the risk of loose material migrating onto the footpath and road where it could become a hazard. Such an apron may involve excavation thus reducing the scope for a drive constructed using the no-dig principles.

The simplest site on which a no-dig construction can be used is where the ground falls into the site from the edge of the road. Level sites should not pose significant problems provided there is an adequately wide verge/pavement to accommodate the 'apron' without severing roots.

It is also important to remember that the no-dig construction needs to tie onto the road and also the levels of the garage or damp proof course of a building.

The roots of a tree will generally grow parallel with the ground surface – they do not grow preferentially up, down or across the slope! As such trees growing on a slope do not present any problems different from those of trees growing on a flat site – it is the engineering requirements that differ! Where the drive crosses the contours at a gentle angle, there is no reason why the depth of a no-dig construction should be constant across its width of a drive. The engineering problem may be how to retain the structure. The scope for increasing the lift on one side of a drive is not unlimited – probably 1:3 should be a maximum (Figure 8).

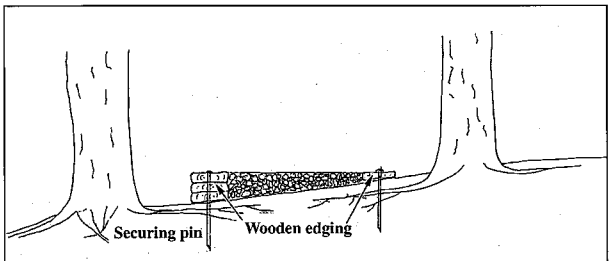


Figure 8. No-dig construction across a slope.

Permanently wet areas of ground should normally be drained, or they may be filled with no-fines stone, or if the water is flowing, they may be partially piped. In contrast, seasonally wet areas may benefit from drainage and building up the ground with coarse stone with a low fines component over which the drive is constructed.

The depth of each layer in the construction of a no-dig drive will be influenced by the bearing capacity of the ground over which the drive will pass. Also there must be consideration of the weight of traffic that will use the drive. The final design should, therefore, be achieved in discussion between a civil engineer and an arboriculturist.

A Potential Benefit

Inclusion of a load spreader in a construction should offer resistance to direct damage often caused to drives and car parks by diameter growth of roots under the structure.

[3] For drives less than 5m wide the finished surface may be constructed of a less permeable material such as asphalt/or reinforced mass concrete.

Adoptable Highways

The above construction is generally unacceptable where the finished structure is to be adopted by a Highway Authority - a more robust specification will be required for example pre-rutting, that is compaction of the ground under the driveway before construction commences, will be required. Such an engineering requirement will usually involve a vibrating roller or repeated tracking of heavy machinery, which is totally unacceptable for the welfare of the tree. The repeated tracking needed to deliver and consolidate layers of aggregate is likely to severely compact the underlying soil at increasing depth. A single pass of a vehicle can cause significant changes in the pore structure in the soil. Repeated passes will further compact the soil which will favour the needs of the engineer, but will eventually create conditions in the soil that are totally unsuitable for root activity and root death will result.

In such circumstances consideration must be given to designing and constructing a running surface which does not require either excavation, or direct compaction of the material under the construction and which does not place a dynamic force on the soil around tree roots. Further, an adopted road is likely to have a width greater than the 5m driveway considered above. The wider the construction the greater the impedance to gaseous exchange between the atmosphere and the soil around roots.

Where a load spreader is acceptable to the Highway Authority there will be need for a greater thickness of no-fines sub-base to support the loads carried by the finished structure[4]. It is then practical to include a system of perforated pipes laid in the sub-base material with venting either at the road surface or in the verges at the edge of the road. The finished surface over the sub-base may then be impermeable to gases (e.g. hot rolled asphalt, or concrete). Inclusion of a 'clay board', or similar over the sub-base may be appropriate to aid casting of the surface.

In the more extreme circumstances a construction to bridge the root system of a very high value tree could be based on an elevated 'board walk' or causeway. That is a series of pads sunk into the ground (causing only localised damage to the root system) supporting beams across which reinforced concrete beams are placed (c.f. a suspended floor in a building). Such a construction would not apply pressure to the ground and so there would not be any threat to underlying tree roots. This removes the need for a load spreader and specialized anchors and edgings.

Final Remarks

Adoption of the no-dig principles for creating access and parking for light vehicles near to trees, which avoids root severance, should help to overcome concerns about possible adverse effects on trees. Nevertheless, successful retention of a tree will depend upon the site in relation to the adjacent highway and strict adherence to the above principles, and upon the tree's condition - indicative of its ability to withstand changes in its rooting environment. This should be assessed by a qualified arboriculturist.

On completion a no-dig construction will be at least 300m above the original ground level.

Acknowledgement

The authors acknowledge the valuable comments and suggestions made by colleagues and members of the Arboricultural Association.

References and Further Reading

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[4] Type 1, as specified by the Highways Agency (2004) is not a recommended aggregate for use around tree roots because it contains a significant proportion of 'fines'.

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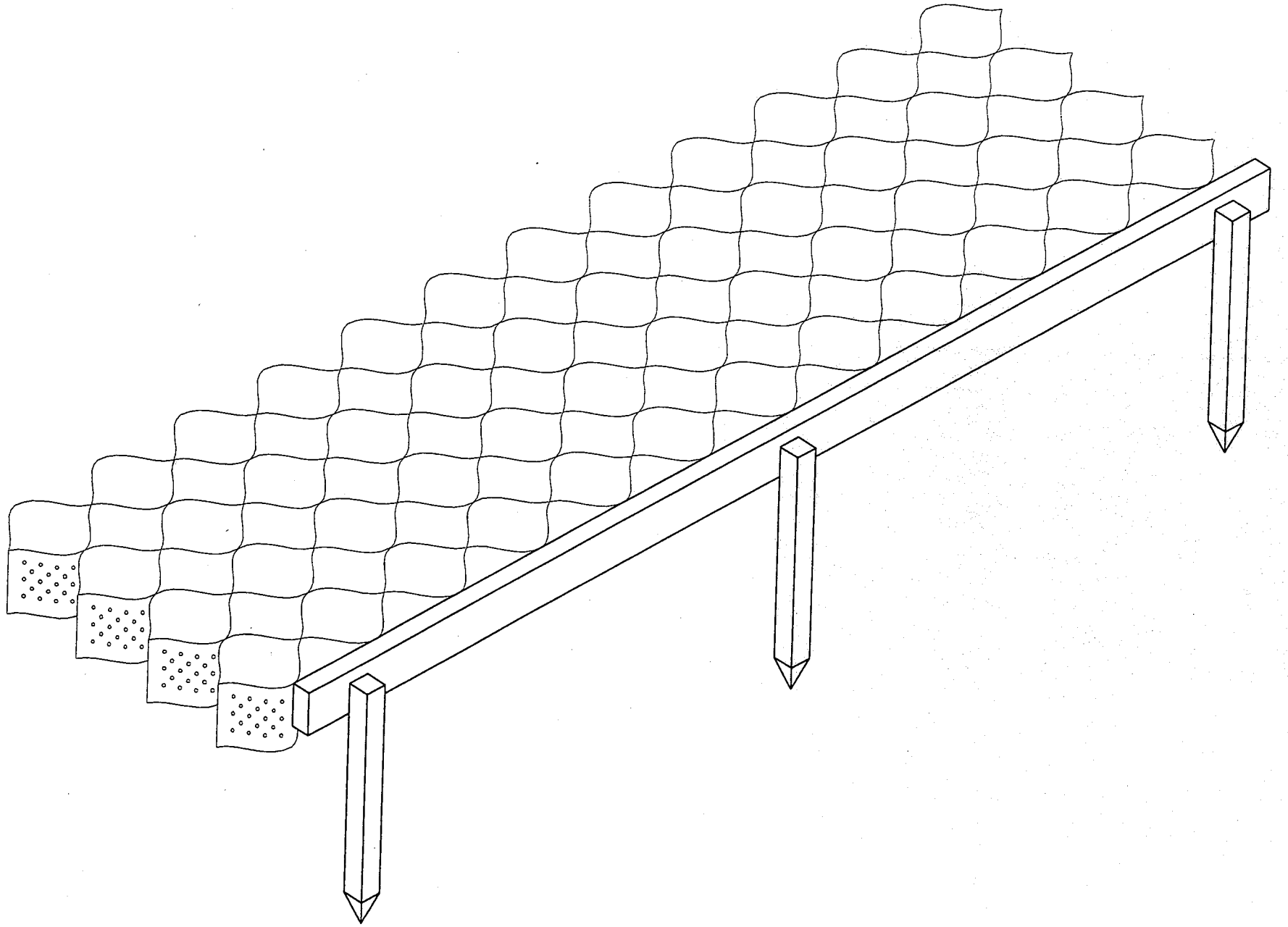
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APPENDIX 3

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