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Going underground; the hidden dimension beneath London's trees

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Dave Cashman is an Associate Director of Barrell Tree Consultancy (www.barrelltreecare.co.uk), a planning and legal orientated tree management practice based in the UK. He has a background in both commercial and municipal arboriculture, but in recent years has developed a practical specialism in subterranean developments near trees in London. These are high profile projects throwing up unusual issues, invariably requiring an open-minded and innovative approach to problem solving. Unlike conventional above-ground developments, there is no well-established or formal guidance to reference when dealing with trees in the subterranean world, so working closely with other professionals is an essential aspect of ensuring that important urban trees can be successfully retained. This paper explores why there has been an increase in underground development and, although the observations are UK based, the principles are likely to be applicable around the world wherever there is limited scope for extending existing properties above the ground.

Inner city land values

During the last few years, the global recession and economic turmoil has had a major impact on many of our businesses and lifestyles. Generally, property prices around the world have crashed, leaving many in a negative equity position. Bucking this trend, prime city locations are still seeing phenomenally high property prices, with the common denominator being their unique position and the limited opportunity for new buildings, which has consistently maintained their value. A recent Dow Jones report identified the most expensive property in the world as the prestigious 'One Hyde Park' development of apartments in Central London, coming in at about $10,000 per square foot. Those following close behind included select properties in Hong Kong, Monaco and Moscow, with Point Piper in Sydney, at around $1,800 per square foot, coming eighth in the table. This common thread of limited opportunity for new builds has pushed up the value of the existing properties and innovative opportunities to increase their size and value is now big business. Where space is so valuable, it is inevitable that

this drive to increase property size will have an impact on the surrounding urban tree resource.

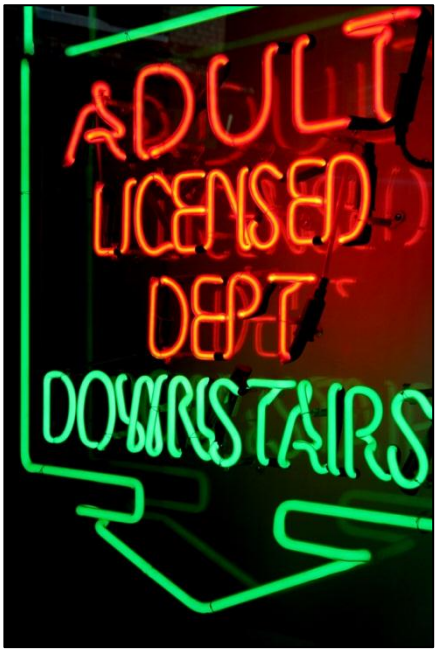
Trees provide many and varied benefits to the community and none more so in our cities where trees, people and infrastructure co-exist in close proximity

Going underground

Land for new properties within Central London is scarce, which puts intense pressure on replacing, sub-dividing or extending existing properties. Over the years most options for extending properties, either out or up, have been utilised reaching their maximum potential in terms of size. Subterranean extensions are becoming increasingly popular and proving to be a cost-effective way of increasing internal floor space and value, without significantly reducing the equally valuable outdoor amenity space.

It is inevitable that modern lifestyles influence traditional ways of using living space, which is often reflected in the interior of London homes. It is not unusual for a typical Edwardian townhouse in Kensington to be dominated from the outside by its unique architecture, formality and sense of space, but on entry to reveal an ultra-modern interior with open-plan living space flooded with natural light and modern features.

Similarly, the small gardens, historically used for storage, have been transformed into modern entertaining spaces, complete with modern luxuries that would have been unimaginable when the spaces were originally designed. Basements fit in with this modern use of space because the interior does not have to reflect the exterior; it is possible to design luxurious and attractive internal space below ground, which reduces pressure existing external amenity space above ground.



Traditionally, basements have often been seen as grim spaces only suitable for storage, among other uses!

In contrast, modern basements can be made into bright, attractive and inviting spaces, providing useful accommodation suited to modern city-living

Planning policy and guidance relating to trees

The Town and Country Planning Act (1990) is the primary policy reference for controlling development within the UK. This includes guidance relating to Tree Preservation Orders and places a duty on councils to ensure adequate provision is allowed for the protection of trees and the planting of trees within the development process. The Act is clear in its support for trees, and states that it is "*the **duty** of the local planning authority to ensure that in granting planning permission for any development adequate provision is made by the imposition of conditions, for the **preservation or planting of trees***". From this overarching national policy, local development plans describe the detail of implementation, which usually includes a requirement to include detailed tree information as part of a planning application. Councils have the option to describe the

detail of their local interpretations in Supplementary Planning Documents (SPD), which often include tree and green space strategies setting out what they expect from development proposals.

More specifically, where development may affect trees, the standard requirement is for a detailed arboricultural report to be submitted as part of a planning application explaining how important trees will be protected during the construction phase, setting out protective measures and sequential construction steps. One of the main London regional councils, The Royal Borough of Kensington and Chelsea, have taken a lead on the matter of subterranean development by publishing a publicly consulted SPD, which includes guidance on trees and landscaping.

In addition to the overarching planning guidance, we also have British Standards (BS) that describes the detail of managing trees in a development context. BS 5837 *Trees in Relation to Construction* (2005) sets out, through the use of flow diagrams and explanations, how trees can be protected in the development process. The concept of Root Protection Areas (RPAs) is central to the guidance and the complexities of building structures within them (above the ground) is now tried and tested, especially on urban sites where space is often restricted. Bespoke foundation designs involving mini-piles with suspended floor slabs allowing both gaseous exchange and water ingress to the roots are commonplace and an accepted part of modern construction. Similarly, no-dig methods for installing hard surfacing is set out within BS 5837 and the use of three dimensional cellular products is becoming standard practice. The thrust is to maintain existing ground levels and limit excavation from the top down, not the bottom up and therein lies the problem; BS 5837 does not deal specifically with subterranean development!

The emerging landscape below ground

London, like many large cities, has a vast world of existing subterranean development, which includes the utilities, sewer networks, sub-stations and rail infrastructure that we rely on to make our cities function. We are often blissfully unaware of the extent of this hidden dimension, as the photographic examples of Leicester Square and Victoria Embankment Gardens demonstrate. Basements in London have always been commonplace, but traditionally they have been used more for storage than as part of the main living accommodation. They are often poorly lit with little or no natural light and damp is a common problem. Furthermore, increasing their size or constructing new

ones is technically demanding and expensive. However, despite the difficulties, as the options for extending above ground are exhausted, subterranean development is fast becoming a means of expanding without encroaching into the sensitivities of the visible above-ground environment. New basements are now being used to house swimming pools, spas, ballrooms, cinemas and, even in one case we are currently involved with, a shooting range!

This plane in the Victoria Embankment Gardens near the River Thames is only 1m above the top of the London tube line

In addition to its great architecture, Central London is famous for its mature tree population and any proposed development that may threaten its long term health or retention is strongly opposed by councils and local residents alike. Large trees in small urban garden sterilise the potential for above-ground development, which only leaves one option! Building basements beneath important trees may sound extreme, but it is happening. Our role as arboriculturists is to assess if it is feasible and, if it is, to then specify appropriate precautionary measures to minimize any adverse impact on important trees. The main problem in that task is that there is a scarcity of specific guidance because the traditional concerns have been focused on the above-ground complexities, rather than the other way round.

The top of a substation that sits beneath Leicester Square in Westminster is only 500mm beneath the famous gardens where Hollywood celebrities promote their latest blockbuster, but is deep enough to fit three double decker buses on top of each other!

Where do we start?

We know from experience here in the UK that the RPA guidance available from BS 5837 allows us to reliably identify the horizontal distance from the trunk that needs to remain undisturbed, but this provides no indication as to what depth this must be observed to. We also know from published material and our own experience that, as a general rule, a significant proportion of the root system is within the top 1m of soil profile and so obviously this depth beneath the RPA must remain undisturbed. Additionally, we know from tree moving reports from around the world that even the largest trees can survive with a rootball depth of 1–1.5m. Of course, this will vary depending on soil type, species and climate, but these disparate snippets of information begin to form a consistent picture, i.e. that in general terms, a starting point for the minimum depth that has to remain undisturbed is around the 1.5m mark.

More specifically, each site will have its own peculiarities and a detailed site investigation is an essential aspect of tailoring the general principles discussed above into more detailed recommendations. Obviously tree species, age and health will have a significant bearing on what an individual can tolerate, which is a standard data collection exercise that all arboriculturists will be familiar with. Similarly, soil conditions and physical obstructions beneath the ground can have a huge impact on the specifics of each case, but this is generally data that will be collected by other specialists. What we know from general tree root behaviour and the site-specific data is then fed into the basement design process to define the limits of disturbance towards and beneath the tree that we assess will be tolerable.

Once all the assumptions have been made, the site investigations have been finished and the discussions within the project team have fine-tuned the detail of the proposal, it is ready for submission to the council for consideration. The Council team will carefully scrutinize the detail and review the assumption to see if they agree the proposal is feasible. If they are not convinced, then they have the option to refuse consent, but if the project team have done their job thoroughly, it is likely that a consent will be issued. However, that consent will carry legally enforceable conditions that are the main means by which the council can ensure that what was submitted on paper is carried out on the ground.

Building basements

Gaining a planning consent is only the start of the process. The logistics of constructing these underground structures is problematic and expensive. Usually there will be restrictive planning conditions requiring arboricultural supervision and record keeping of the construction sequence to ensure the trees are protected during this difficult phase. Within the project team, there is always pressure to deliver the project on time and within budget, and any scope for cost cutting is pounced upon by the quantity surveyors. It is at this stage that trees can be overlooked and a robust tree officer, insistent on regular site supervision is an essential ingredient of a successful project. Fortunately, the tree officers working in these central London councils are experienced individuals and used to dealing with slippery developers. A pre-commencement meeting with the tree officer and key members of the project team is important to ensure the project gets off to a good start. Full briefings to all relevant personnel, regular supervision visits and a clear audit trail are essential to demonstrate the

sequential construction programme and tree protection measures agreed as part of the planning consent have been properly implemented.

On a practical level, basement extensions are generally constructed by underpinning the existing foundations and excavating the soil beneath the supported foundations. The process usually starts from within the footprint of the building and works out to the basement extremities, excavating and shoring up as the work progresses. It is common to use the technique of horizontal piling, which is an established construction method used where constructing from the top down is not feasible. It is particularly useful for basements because it allows the surface layer of soil to be isolated from the main excavation area deep beneath the surface. It involves pushing piles horizontally through the soil at the required depth, supporting that temporary stabilizing platform so the soil above (and the tree) remains undisturbed, excavating the soil beneath and constructing the new structure in the void. Basement projects commonly extend 10–15m below ground level, with a 1.5–2.5m layer at ground level undisturbed, allowing trees to be retained and creating no outward change to the visual character of the locality.

Essential ingredients of a successful project

In our experience, a successful basement project relies on a team of professionals contributing in a co-ordinated way. Tree expertise is an obvious requirement in that equation, but so is the need for all the team to interact in a constructive and professional manner. Early involvement of an arborist with the design team is critical to ensure the tree issues are properly considered from the beginning. We find that understanding the project, managing the client's aspirations and being able to provide clear, realistic advice to the designers are essential aspects of making it all work. We also find that, due to the extremely high costs and tempting rewards, there is often considerable pressure on consultants to push the limits as far as possible.

Subterranean development is being increasingly seen as an innovative and sustainable means of providing more living space in inner cities while retaining equally as valuable external amenity space. Arborists have an important role to play in this process and their continued involvement is essential if trees are to be successfully retained where they are most needed, at the heart of our cities.

Dave Cashman
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