

PRESERVATION OF A LARGE CHINESE BANYAN ON A CONSTRUCTION SITE

by C.Y. Jim

Abstract. Trees on buildings sites are routinely damaged or felled in Hong Kong due to negligence and lax control. In an unprecedented move, the government required the developer of a large well-wooded lot to retain one large Chinese Banyan (*Ficus microcarpa*) tree and take necessary measures to ensure its long-term survival. The size, fine condition, species rarity, longevity and setting justify its preservation. Great costs (about US\$120,000) was needed mainly to construct a 18 m diameter and 10 m deep reinforced concrete planter in site above five stories of shops and carparks. Routine arboricultural inputs, such as phased pruning of crown and roots, installation of aeration and irrigation facilities, and fertilization, are prescribed. Special precautions, including regular monitoring of watering and fertilization to minimize risks of physiological stresses, are justified in view of the costly preservation.

Résumé. Les arbres autour des édifices à Hong Kong sont souvent endommagés ou détruits dû à la négligence et à un contrôle relâché. Dans un geste sans précédent, le gouvernement a exigé d'un développeur possédant un lot bien boisé, de conserver un gros *Ficus microcarpa* et de prendre les mesures nécessaires pour assurer sa survie à long terme. Sa grosseur, sa bonne condition de santé, la rareté de cette espèce, sa longévité et son emplacement justifiait la préservation de cet arbre. Des dépenses importantes (environ 120,000 \$US) furent requises pour construire un contenant en béton de 18 m de diamètre et d'environ 10 m de profondeur au-dessus de cinq étages de magasins et d'espaces de stationnement. Plusieurs traitements d'arboriculture tels que des élagages successifs de la cime et des racines, l'installation d'un système d'aération et d'irrigation, et la fertilisation furent prescrits. Des précautions spéciales, incluant un contrôle régulier des besoins en arrosage et en fertilisation afin de minimiser les risques de stress physiologiques, sont aussi justifiés suite aux sommes investies pour préserver cet arbre.

Trees on construction sites are often extensively damaged or felled during development. For the few that are preserved, the maltreatments received during construction often cause long-term decline and eventual death despite strenuous efforts to sustain them (1, 4, 8). Soil disturbances such as structural and chemical degradations, or changes in grade and the groundwater regime, are particularly destructive with long-lasting effects (2, 10). In high-density, urban Hong Kong, few trees exist and most trees on and adjacent to construction sites are routinely eliminated. City expansion into wooded areas is often preceded by wholesale felling without any attempts to save trees in open spaces and along roadsides (6, 7).

Expectations for a greener and more livable city are marked by recent urgings from conservation groups to preserve exceptionally large trees threatened by expansion and redevelopment. A large (16.8 ha) and well-wooded site formerly occupied by army barracks was recently released for civil use. This green enclave was situated on a hillslope adjacent to the central business district in the heart of the city. The government yielded to strong public pressure to retain 80% of the area as an urban park and communal open spaces, leaving the rest for roads and buildings. The portion destined for development nevertheless contained patches of fine woodlands. Some 40 mature trees deserving preservation, of which five are exceptionally large and beautiful, were identified in a tree survey. Unfortunately, only a few are left after the destructive excavations associated with site formation by cutting back the slopes to form building platforms.

In an unprecedented move, a Chinese Banyan (*Ficus microcarpa*) tree situated on the last lot to be auctioned was earmarked for preservation by the government's land authority. A special clause in the lease stipulates that the developer has to preserve the tree at its present position and ensure long-term survival at their expense and to the satisfaction of appointed government agents. After acquiring the land at great costs, the developer attempted to convince the government that the tree might not survive the stresses associated with construction and should be transplanted to a nearby public area. The proposal was rejected, and elaborate plans were drawn up to preserve the tree while maximizing the development potentials of the land. This paper discusses the combination of engineering and arboricultural measures used to save the tree and ancillary implications.

Tree Characteristics

Ficus microcarpa, commonly known as Chinese Banyan or Small-leaved Banyan, is a member of the large *Ficus* genus that has a wide

geographical range covering tropical and subtropical Asia and the adjacent areas (5). It is an evergreen tree that can reach a final dimension of 30m height, and a rounded-spreading crown 1½ times wider than tall in uncluttered environments. It has the propensity to grow aerial roots that can upon reaching the soil quickly thicken into root stands that serve the functions of trunks. In exceptional circumstances, a single tree with hundreds of such stems can cover a large area. Besides its large size and majestic tree form, it is known for longevity (several hundred years) and tolerance of a wide range of soil and microclimatic conditions, including those in cities. Its use in Hong Kong has declined recently because the final size and the searching roots cannot be accommodated in increasingly crowded city (6). Large specimens are rare and most are in poor condition and located in cramped spaces.

The tree of interest was planted on a platform between two three-story army barracks which had since been demolished. It is a sizeable specimen with a 2m dbh, 15m height, 22m crown spread, and an estimated age of 60 years (Fig. 1). It is reasonable to expect the tree to live for at least 100 more years and attain a bigger final size. Despite a lack of arboricultural care, it has only a few broken and dead branches, and is generally

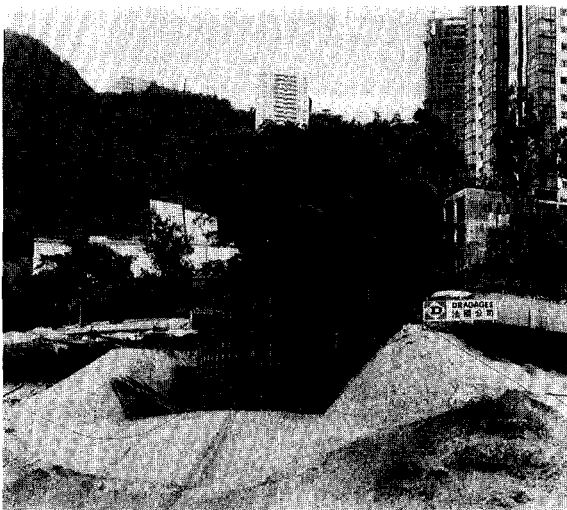


Figure 1. The Chinese Banyan (*Ficus microcarpa*) perching on the colluvial slope that has been cut back. Its roots are contained in the soil mass surrounded by sheet-piles which form the vertical wall of the huge concrete planter at 10m deep and 18m diameter.

healthy and vigorous. The crown is unusually rounded, symmetrical and complete, giving the tree a graceful form that is rare in urban settings. The surrounding grounds were paved with concrete and the trunk base was sheathed by a 1.7m deep and 5m diameter concrete collar [probably before the Second World War (9)], indicating a reduction of the original soil level since planting. The soil, a well-drained and coarse-textured, deep, colluvial deposit, shows signs of disturbance from previous construction activities. The potential amenity value is high in view of its location as a living landmark amidst tall buildings and the artificial environs. It can serve as an accent specimen contributing significantly to the local landscape.

Preservation Methods

Engineering measures. The retention of the tree was complicated by the developer's intention to build five stories (shops and carparks) below the tree (Fig. 3). In essence, a huge concrete planter 10m deep and 18m diameter was constructed to contain the rooting soil mass and was thus detached from the surroundings. Engineering procedures were started after root pruning and other arboricultural attentions (see next section). Initially, contiguous sheet-piles were inserted vertically around the 18m-diameter perimeter as temporary support (Fig. 1). The piles were driven in short sections to avoid damaging the crown. Five caissons were then excavated outside the piles, and reinforced-concrete columns were cast inside

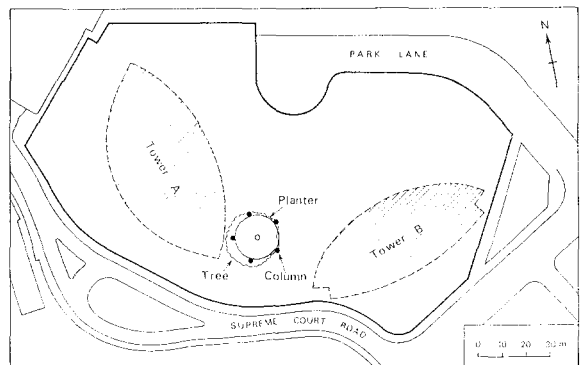


Figure 2. Location of the Chinese Banyan tree in relation to the two tower blocks to be erected on the site. Note the size of the planter in relation to the crown, and that of the crown in relation to the narrow gap between the two towers.

the shafts to support the planter and the underlying floors (Fig. 2 and 3).

The soils around the sheet-piles were removed to allow contiguous hollow steel casings to be driven horizontally into the bottom of the enclosed soil mass. The soils inside the casings were bored out and prefabricated steel beams inserted. The spaces between the casing and beam were grouted with concrete. Excavation under and around the new floor-slabs provided room to install steel plate girders and haunch brackets which were linked to the supporting columns (Fig. 3). Finally, reinforced concrete beams were cast below the floor-slabs and walls encircling the sheet-piles to give a permanent shell to the planter. Drainage pipes and outlets were installed at the bottom. Thereafter, the top-down construction of basement floors could proceed while the tree was protected by sufficient hoardings against

above-ground construction damages.

Arboricultural considerations. In preparation for root containment, dead, broken, and diseased wood was removed from the tree and cable bracing was installed to support the trunk and main branches. In addition, an irrigation basin was made and gravel-filled aeration tubes and an irrigation system were installed. Roots were pruned at approximately the drip-line in two stages to minimize shock. The initial trench, 0.75m wide by 1.5m deep, was followed after two months by a larger trench of 1.5m wide by 2.5m deep. To stimulate fibrous-root growth (3) trenches were immediately refilled with coarse materials. Root distribution and size above 10mm diameter in the trenches were recorded at the time of trenching and are plotted in Fig. 4. All roots greater than 10 mm were found in the top 1m of soil, indicating that the planter was adequate for the tree at present. The large

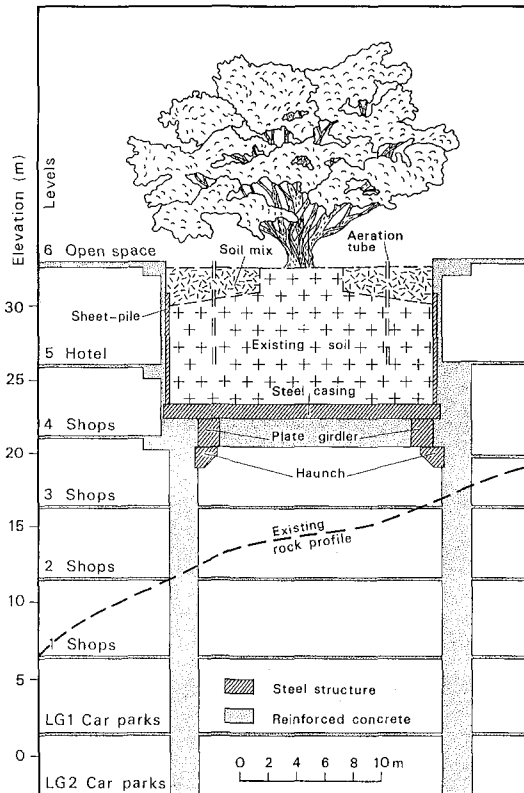
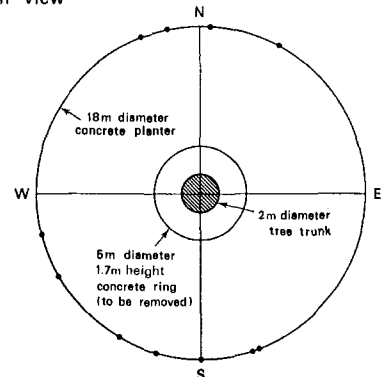


Figure 3. Engineering measures adopted to create a huge concrete planter. The steel structures provide temporary supports whereas the reinforced concrete provide the permanent casing for the planter. Construction proceeds top-down from the bottom of the planter (Source: adapted from diagram supplied by contractor).

(a) Plan view



(b) Wrap-around elevation

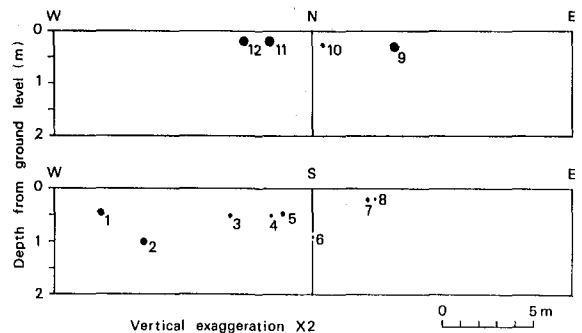


Figure 4. Distribution of roots over 10mm diameter on the walls of the root-pruning trenches. Note the concentration of roots in the top 1m of the soil, and the paucity of roots at the 18m perimeter (Source: adapted from diagrams supplied by contractor).

rooting volume ensures a sufficient reservoir for the storage of available moisture, reduces the shock of root pruning, and allows future expansion of the root system. The removal of the concrete collar and pavings around the tree and the raising of soil to its original level (Fig. 3 and 4) may be detrimental to the roots. The use of coarse soil fills and the installation of vertical, gravel-filled, aeration tubes are necessary to maintain air exchange in the buried soil.

Routine cares, such as irrigation, addition of compound fertilizers, weeding, and maintenance of a continuous groundcover of perennial herb (*Wedelia chinensis*) to protect the topsoil structure and infiltration, should be given regularly. Scheduled inspections by arborists and government landscape architects monitor its progress to ensure that any problems are quickly diagnosed and remedied. Long-term growth of the tree faces some problems. Crown expansion will be hindered by the too-closely-positioned tower block (Fig. 2). Continual pruning necessary to trim excessive lateral growths may prevent the tree from attaining final dimensions and disrupt natural shape. Occasional typhoons may seriously damage or uproot the tree with weakened anchorage. Anchor cables should therefore be installed to reduce the risk of windthrow. The rooting volume, presently rather generous, may not be adequate as the tree expands towards its final size. Divorced from natural groundwater supplies, the soil moisture regime with a diminished buffering capacity will fluctuate between extremes. The funneling of winds between the two towering blocks and reflection of sunlight from the glassclad surfaces will increase the evapotranspiration rate and the risk of stress due to water deficiencies. Moisture-laden winds flowing down from the adjacent well-wooded slopes may provide some relief. A carefully regulated irrigation program coupled with efficient drainage, analogous to watering a flower-pot, is imperative.

The high cost of preserving the tree warrants special treatments to ascertain an optimal growth. Installation of tensiometers at different depths can monitor soil moisture suction and availability, and provide reliable criteria to adjust the timing and quantity of irrigation. Overwatering must be avoided especially in view of the poor drainage. The

drainage pipes and outlets at the bottom of the concrete container should be kept clear to avoid waterlogging. Fertilization needs should be determined objectively by annual analysis of soil and foliage samples. The risks of excessive application of chemical fertilizers including plant burning and salt accumulation can thus be minimized. Organic fertilizers can supplement chemical ones to maintain a porous granular structure in the topsoil. The deposition of cement dusts on foliage during construction can be washed down by sprinklers or rainfall. The contaminated washings will enter the enclosed soil mass through canopy drip and stem flows, and may raise soil pH. The acidic soil (around pH 5.5), the inherent buffering capacity against fluctuations in soil reaction, and the wide range of tolerance of Banyan trees to pH, are mitigating factors. Monitoring of pH and laboratory testing of pH changes versus cement dust additions are necessary.

Conclusions

One tree out of many that deserve preservation has been saved on a new development area through government intervention. The desire of the developer to maximize the use of the costly land has complicated the preservation procedures. The opportunity costs of additional efforts and delays, and the actual costs (estimate US\$120,000) of engineering and arboricultural inputs, are substantial. The expenditures incurred, however, are justified in economic terms in view of the huge investments in land and buildings, and the profits gained from the extra floor spaces. The amenity value to the site and the community at large, though irrefutable, becomes almost incidental in the calculation.

This is a case of tree preservation imposed by the government on the developer who would otherwise routinely eradicate all trees in a building lot. It provides a pioneering example in Hong Kong of a building plan adjusted to accommodate an existing tree, and demonstrates the need for arboricultural care to protect trees from construction damages. Though the engineering measures are overriding, the sensible and timely arboricultural inputs are indispensable. It is hoped that similar plans to preserve trees in development areas can be taken more earnestly by the govern-

ment, and especially voluntarily by the private sector. The need to save good-quality existing trees sympathetically in building-plans, town-plans and open spaces should be more strongly emphasized, if not made mandatory.

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Cultivars of *Salix babylonica* and other Weeping Willows

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Abstract. *Salix babylonica*, the classical "weeping willow" from China, is now regarded as including *S. matsudana*. The species is represented by several valid cultivars, including 'Babylon', which is proposed here for the first time for the female clone upon which the original species description may have been based. Since 'Babylon' is not cold hardy in many areas of the United States, the most commonly planted "weeping" willows are actually hybrids between 'Babylon' and *S. alba* or *S. fragilis*. Unfortunately, many of these hybrids suffer from cold-related twig dieback, their nomenclature is hopelessly confused, and several different clones may be growing under the same cultivar name. It is proposed that most of the older names used to denote cultivars and selections be abandoned and new names, based on plants propagated from living, documented specimens, be used in the future.

Résumé. *Salix babylonica*, le saule pleureur classique de Chine, est maintenant considéré comme incluant *S.*

matsudana. L'espèce est représentée par plusieurs cultivars valides, incluant "Babylon", qui est proposé ici pour la première fois comme le clone femelle sur lequel la description première de l'espèce fut basée. Étant donné que la variété 'Babylon' n'est pas rustique dans plusieurs régions des États-Unis, les saules pleureurs les plus communément plantés sont des hybrides entre "Babylon" et *S. alba* ou *S. fragilis*. Malheureusement, plusieurs de ces hybrides souffrent d'un dépérissement causé par le froid, leur nomenclature est très confuse, et plusieurs clones différents croissent sous le même nom de cultivar. Il est proposé que la plupart des vieux noms utilisés pour dénoter les cultivars et les variétés soient abandonnés et que des noms nouveaux, basés sur les plants propagés par voie végétative, des spécimens bien identifiés, soient utilisés dans le futur.