# TRANSPLANTING TWO CHAMPION SPECIMENS OF MATURE CHINESE BANYANS

by C.Y. Jim

**Abstract.** Recent expansion of a urban-situated racecourse in Hong Kong proposed felling two champion specimens of mature Chinese Banyans (*Ficus microcarpa*). In response to public outcry, they were transplanted at great cost to a nearby site. The arboricultural-cum-engineering measures used to move the large trees, an unprecedented operation locally, are explained. The hydraulic approach conveying the trees held in 8 m diameter steel containers running on rails was workable but expensive. The impacts on the trees, and implications on the community's attitude towards trees and their welfare, are discussed.

Densely built-up urban Hong Kong is unfavorable to tree growth. Tree quantity and quality, especially at roadsides, are below expectation (20). Fine specimens of outstanding or champion trees are rare and mainly found in offroad sites (21). Above-average performance occurs occasionally by default due to fortuitous combination of genetic superiority, genial environment, and freedom from injuries and diseases. Such trees deserve special protection as precious community heritage (25,26,31). In many countries, their preservation is often firmly secured by statute (28,30).

In Hong Kong, however, even the highest-caliber trees can be damaged or felled by development. The law does not impart special status to elite specimens. A recent project to expand the racecourse, which is located within densely built-up neighborhoods, required removal of many fine mature trees. Two extremely beautiful Chinese Banyans (*Ficus microcarpa*) of over 100 years old (Figure 1 and Table 1) were initially destined for removal. In response to public outcry, the Jockey Club decided to transplant them at great cost to an adjacent location.

Transplanting large trees requires special skill, care and equipment (3,4,10,14,27). The operation differs from transplanting nursery stock of smaller size (1,17), although the principles and methods have similarities. This paper studies the background to the transplanting of two large Chinese Banyans in Hong Kong, the preparatory work and associated arboricultural and engineering measures, and an evaluation of the pros and cons of the exercise in the light of community response.

## The Champion Specimens

The two Chinese Banyans originally grew on the footpath of a narrow side road (Sports Road). They were over 20 m tall with even wider crowns. The surrounding land use is mainly open and turfgrass sports fields, and the road has little vehicular or pedestrian traffic (Figure 1). The environment is conducive to excellent tree performance. They are believed to have been planted some 140 years ago when the environs, then a waterlogged marsh, were drained to build the racecourse (2). As Hong Kong was founded 154 years ago, they are as old as the city itself. The continuous sportsground usage of the area ensured a sustained genial habitat for the trees to flourish (19). The surrounding open soil and lack of buildings provided an unhampered condition in comparison with ordinary street trees (23,24).

The native Chinese Banyan has been the shade tree par excellence of south Chinese settlements for centuries. It symbolizes strength, stability, sturdy health, longevity, and perseverance despite the odds. Of the 356 champion trees in urban Hong Kong enumerated in a recent survey (22), one-third are Chinese Banyans. Most were planted over 100 years ago when the embryonic city could afford the space. Many have since perished or been badly damaged due to relentless urbanization. The existing outstanding specimens are therefore precious living relics that demand special care.

## The Transplanting Proposal

The Jockey Club proposed in 1992 to expand

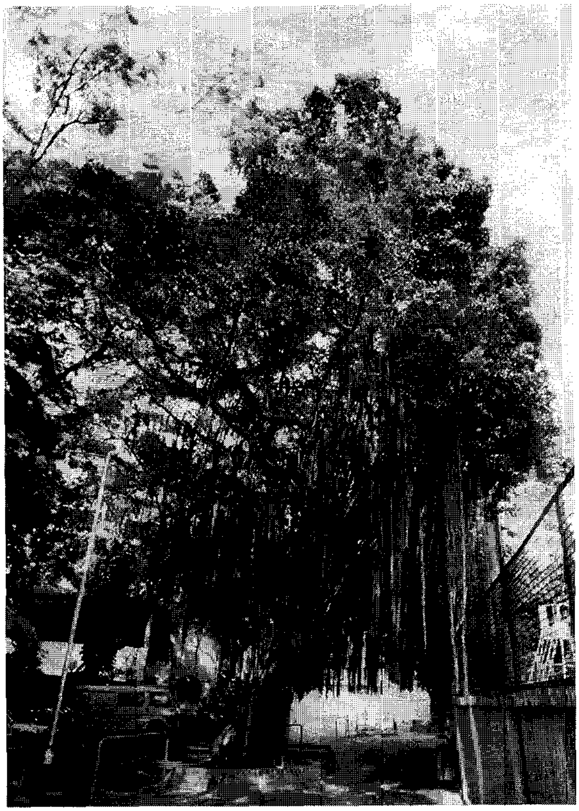

**Figure 1. The beautiful tree A situated in a tree pit on the edge of the footpath in Sports Road photographed before crown reduction. Note the unusually abundant growth of aerial roots which bestow a unique character to the specimen.**

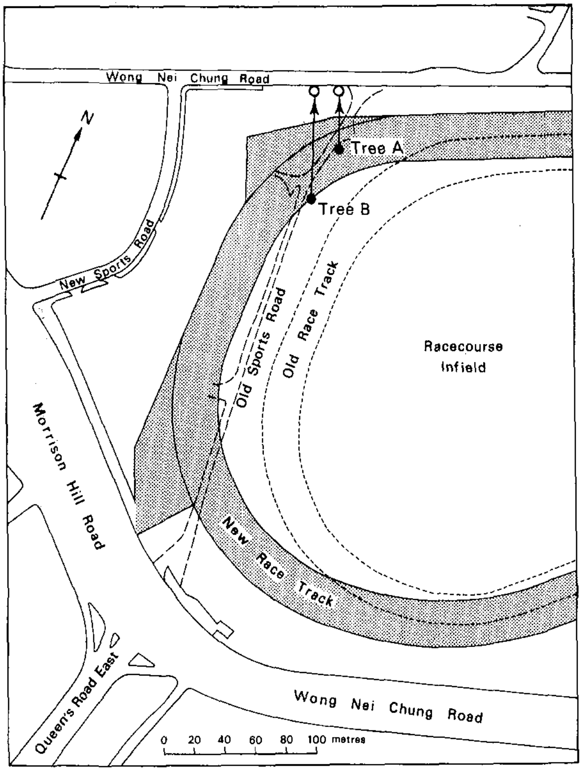


**Figure 2. The original and destination locations of the two transplanted Chinese Banyans. Note the alignment of the old and new race tracks in relation to tree positions, and the new Sports Road.**

the racecourse, in particular to upgrade the late-1840s race track to international and modern standards (Figure 2). A master plan to enhance the landscape and traffic conditions for the entire area was prepared. A tree survey identified 273 trees in the affected area, of which 87 were to be transplanted and the rest felled. The two Chinese Banyans in question were deemed by the Club's landscape consultant to be too big, too old and past their prime, and hence were earmarked for removal. They straddle the new race track, and suggestions to shift the alignment or accommodate the trees sympathetically into the design were rejected.

The Jockey Club offered massive tree planting for the environs, including the use of semi-mature Banyans, partly as compensation for the lost trees. Public opinion, however, showed a vociferous objection to cutting these exemplary specimens. The developer eventually yielded to the preservation urge and commissioned a study on transplanting feasibility. In general, Chinese Banyans are known for their tolerance of drastic crown and root losses, and stand a good chance of surviving the transplant shock. The present two trees were to be transferred 32 m and 57 m respectively to the north and lodged in a proposed roadside amenity strip (Figure 2). The operation would be difficult but manageable in engineering terms.

## Rootball Preparation

Two years were allocated to the transplanting process. Starting in mid-1993, preparations were made to form the rootball. The carriageway of Sports Road was shifted towards the west to widen the work area around the trees to about 10 m. Paving materials under the canopies were removed to expose the soil and enhance aeration to the roots. Underground utility lines, including a 132 kV electricity cable, were shifted away from the excavation areas. Mulch was spread on the soil surface to reduce water loss and lower soil temperature (13). Boardings of 2 m tall were installed around the work area, with windows for public viewing.

Crown reduction preceded root pruning. About half of the crown was removed quite drastically, including major branches and limbs (Figure 3). A sprinkler system to produce a fine mist was installed in the crown to reduce foliage temperature and dampen transpiration. The trunk and limbs were wrapped with hessian to lower temperature and the possibility of mechanical injury. Root pruning was phased over four stages, each dealing with a quarter, over two growing seasons (1993 and 1994). A 2 m deep and 1 m wide trench was dug manually at 4 m from the trunk, regarded as deep enough to encompass most roots, since Banyan roots tend to concentrate in upper soil (29, 32). All exposed roots were cut cleanly, and the trench was backfilled with a sterilized loamy soil mix amended with peat to encourage the growth of fibrous absorption roots (8).

**Figure 3. Tree A shortly after massive crown reduction. Note the loss of most foliage and twigs, and cutting down to major branches and limbs.**

A permanent circular drainage-cum-irrigation system was placed near the bottom of the trench before backfilling. Corrugated PVC drain pipes of 15 cm diameter were used. Vertical risers protruding above the soil surface and connected to the circular drains were also installed. The system also serves to improve aeration. Soil moisture sensors were set up to monitor water status and guide the irrigation regime. Frequent watering ensured a moist soil most of the time.

## Engineering Preparation

The transplanting weight, the bulk of which consisted of the soil, amounted to 309 and 286 Mg for the two trees (Table 1). The massive crown

**Table 1. Relevant dimensions and weights related to the transplant of two mature Chinese Banyans.**

| Attributes | Tree A | Tree B |
|---|---|---|
| Original tree height (m) | 23.9 | 20.3 |
| Reducted tree height (m) | 14.5 | 15.2 |
| Original crown spread (m) | 21.7 | 30.5 |
| Reduced crown spread (m) | 13.1 | 15.9 |
| dbh (m) | 2.1 | 1.8 |
| Original tree weight (Mg) | 167.6 | 104.6 |
| Reduced tree weight (Mg) | 101.7 | 78.3 |
| Container diameter (m) | 8.0 | 8.0 |
| Soil depth (m) | 1.8 | 1.8 |
| Soil volume($m^3$) | 90.5 | 90.5 |
| Soil (saturated) weight (Mg) | 187.3 | 187.3 |
| Steel structure weight (Mg) | 20.0 | 20.0 |
| Total transplant weight (Mg) | 309.0 | 285.6 |
| Transfer distance (m) | 32.0 | 57.0 |
| Transfer gradient (%) | 8.0 | 4.0 |
| Original level (mPD) | 4.8 | 4.8 |
| Destination level (mPD) | 6.9 | 6.9 |

Estimate of tree weight: $[(\text{dbh} \times 1.5)/2]^2 \times$ [tree height] x [density of living tissue reckoned to be 0.9 $Mg/m^3$].

Estimate of soil weight: [soil volume] x [(dry bulk density of soil reckoned to be 1.72 $Mg/m^3$) ÷ (0.35 $Mg/m^3$ of soil moisture held in 35% porosity)].

Estimated weight of steel structure given by project engineer.

Container diameter varies from 7.0 to 9.0 m, with the midpoint used in calculation of soil volume.

Figure 4. Tree A about 18 months after crown reduction. Note the regrowth of some foliage mainly as sprouts from cut faces, the base plate supporting the steel container, and the beams propping the tree.

reduction managed to trim only a small proportion of the load. Lifting was ruled out, and so the sledge method was adopted. Customary wrapping of the rootball using hessian or a wooden box could not handle the weight. A high-strength steel encasement was necessary instead. A container using 4 mm steel sheet reinforced by steel tubes, all welded together, was constructed at the time of root pruning (Figure 4).

The loss of stability due to root severance was compensated by propping with steel beams attached to the upper edge of the container. The interfaces between steel and wood were cushioned by high-density rubber mats. The supports were essential because of the possibility of typhoons in Hong Kong.

With the opening of a new Sports Road (Figure 2), the old one was closed. A wide conveyance channel was excavated to connect the old and the new tree sites. Due to a difference in elevation of 2.1 m, the channel had to rise towards the destination. A 9 m square base plate was then inserted underneath the container (Figures 4 and 5). The original plan was to winch a cable below the container and insert U-shaped steel sections. Instead, a high-pressure water jet was employed to tunnel the sandy soil of loose consistence. Steel beams were inserted one by one contiguously to form the base plate. Props, connecting the base plate to the container wall and to the tree, were added to provide more support (Figure 4).

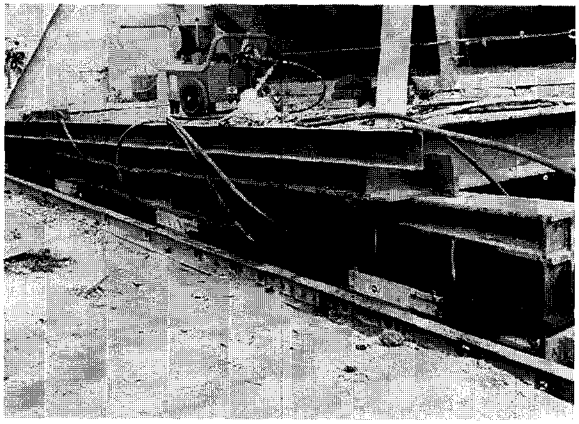

Figure 5. One of the two angled sledge units that wedge below the base plate. Note the four hydraulic shoes which continuously level the tree, and the rail on which they rest.

As the trees had to climb a slope of 8% and 4% respectively, two more sets of beams with an oblique bottom corresponding to the slope angle (Figure 5) were added. They were fixed under the two sides of the base plate parallel to the moving direction, and served as the sledges on which the whole set-up would be pushed.

## The Conveyance

The trees were ready to move in March 1995. The original idea of using rollers below the base plate and pulling by tractors was not used. An hydraulic approach was adopted instead. The trees were to ride on rails and be pushed by hydraulic jacks. For each tree, two rail bedding made of reinforced concrete with embedded bolts were built (Figure 6). Steel rails were then fixed

**Figure 6. Tree A on the left and tree B on the right behind it immediately before the transfer. Note the construction of reinforced concrete rail bedding on which the tree would slide on rails towards the destination.**

onto the bolts, and the set-up was pushed at the back (downslope side) by two powerful hydraulic jacks each capable of generating 38 Mg.

To balance the trees during conveyance, eight hydraulic shoes were installed at the bottom of the sledges (Figure 5) for gimbals-like continuous leveling adjustment. The bottom of the shoes were made of bronze and lubricated to facilitate the sliding on the rails. To ensure a smooth ride, the rails must be built parallel to each other and run on a constant gradient. The two hydraulic jacks had to pushed at the same rate. At a designated speed of 6 meters per hour, the travel was completed within a day.

The new site was excavated down to the requisite level and cleared of underground services. Sandy soil of good drainage was spread as a pad on the resting spots. Tree B was equipped with a steel pipe going though the rootball to allow an essential utility line to run through. Shortly after reaching the destination, the container and the base plate were removed. The rails and their concrete bedding were also dismantled. Props were installed to stabilize the trees. Soil was added to fill the site up to its designed grade, with the physical properties of the added soil matching those in the container to avoid problems of discontinuity (5). Fertilizers and water were added when needed and the trees were regularly inspected. Thus far in September 1995 they have not shown signs of undue stress.

## Discussion and Conclusion

The crucial concern is the massive loss of roots. The rootball, measuring 8 m across and containing some 91 $m^3$ of soil, may be large in absolute terms. It is, however, very inadequate in comparison with the large tree size. The trees with original crown spread of 21.7 m and 30.5 m and height above 20 m, are likely to have roots extending well beyond their driplines (15, 29). If we were to consider a common rule of thumb, of having a rootball diameter nine times that of dbh for large trees (3), a container of 18 m diameter would have had to be built! Such a dimension is unrealistic and would pose engineering difficulties in the move. However, the present 8 m diameter container could mean that about 90% of the soil volume from which the trees obtain their sustenance had been lost. This is based on the assumption that roots spread to a circular area of 25 m diameter and that most absorption roots lie outside the dripline (6,7).

The removal of over half of the crowns was perhaps unnecessary. Moreover, the reduction method is more like pollarding than a less destructive crown reduction and thinning. Cutting was made down to major branches and even limbs. The need to balance root losses by substantial top removal so as to regain the root:shoot balance (11) seems to have been overdone. The need for excessive reduction has been cast in doubt (9). The disfigured tree form is unlikely to be re-gained. The loss of the majestic curtain of aerial roots in tree A has robbed the tree of its very charm and character. The resprouting even before the transplant (compare Figures 3 and 4) shows a unnatural shape. Whereas the yet unsevered roots might have provided the nutrients, some of the stored reserves in the trunk could have been mobilized (33). The augmented heat and pollution at the new site could impose a stress regime (12) more typical of local urban roadside (19).

As a joint arboricultural-engineering endeavor, the project was feasible. In cost terms, estimated to reach 1 million US$, it has been considered as excessive and perhaps not worthwhile. It can be argued that if the government approved the development, it should have allowed felling the trees. The huge sum of money earmarked for transplanting could well be devoted to a generous tree-planting program to benefit more areas and more people. Instead of spending on greening, much of the expenses have gone to engineering.

The event has aroused the community's awareness of the importance of trees in the harsh urban environment, and of the need to preserve the good-quality stock. In the future, the excuse that a tree is too big to transplant, often used in the past, will no longer be tenable. Trees in other development projects in recent months are already benefiting by this effect. This pleasant by-product, perhaps somewhat unexpected by the Jockey Club, is something to be proud of, and perhaps help to make the expenses truly worthwhile. It is hoped that the impetus to changing societal attitude towards trees can be sustained.

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**Résumé.** L'agrandissement récent d'un champ de courses situé dans la zone urbanisée de Hong Kong impliquait l'abattage de deux gros banians chinois (*Ficus microcarpa*) champions. En réponse aux protestations du public, ces arbres ont été transplantés à grands frais sur un site à proximité. L'article décrit les mesures d'ingénierie arboricoles qui ont été employées pour le déplacement des arbres, une opération sans précédent au niveau local. Le système hydraulique employé pour déplacer les arbres dans des conteneurs en acier de 8 m sur des rails a été bon mais couteux

**Zusammenfassung.** In den jüngsten Erweiterungsplänen einer im Stadtgebiet von Hongkong liegenden Rennbahn wurde die die Fällung von zwei ausgewachsenen bildschönen Exemplaren der chinesischen Feige (Ficus microcarpa) vorgeschlagen. Als Antwort auf den Aufschrei der Bevölkerung wurden die Bäume mit hohem Kostenaufwand an einen benachbarten Standort verpflanzt. Hier wird der ingenieurtechnische Aufwand ausgebildeter Baumpfleger zum Bewegen der großen Bäume erklärt. Die Operation war beispiellos. Das hydraulische System, welches die Bäume in Stahlcontainern mit 8 m Durchmesser auf Schienen beförderte, war einsatzbar aber sehr teuer.