

# **Guideline on Pavement Renovation Works and Tree Stability**

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## **1. Introduction**

There is a keen competition for space in urban area. Trees are often found growing in tree pits or planters surrounded with concrete in paved area, with solid paving very close to the tree trunks. These trees often suffer from restricted growing space and the lack of air and water under impermeable surfaces. In some cases, tree roots grow vigorously and even uplift the pavement. While in other situations, roots may be cut off or damaged during pavement repair work.

A way to improve the growing environment of existing trees in paved area with confined growing space is to increase the area of permeable surface for better water and air movement to roots by removing or opening up the impermeable hard paving in a timely manner. However, precautionary measures have to be appropriately planned and implemented to ensure the stability of trees before works are undertaken.

## **2. Root Biology**

Tree roots serve the primary functions of anchorage, storage, absorption and conduction. Larger roots play a major role in anchorage, storage, and conduction. Absorbing roots are small, fibrous, primary tissues that grow at the ends of and along the main, woody roots which are important for water and mineral uptake. Roots grow where moisture, nutrients and oxygen are available in soil. As a result, most absorbing roots as well as the horizontal,

lateral roots grow near the soil surface. As roots need oxygen for growth, they do not penetrate into the compacted, oxygen-poor soil under impervious paved surfaces.

### **3. Ensuring Tree Stability for Pavement Renovation Works**

Trees are highly adaptable to the surrounding environment. When roots come in contact with a hard surface, such as a concrete footpath or kerb, they tend to grow along the hard surface and sometimes even integrate with features such as tree grilles when tree pits are not enlarged or tree grilles not removed / adjusted in a timely manner. (Fig. 1).

For some tree species with aggressive roots, they may lift the paving when their roots grow under the paving (Fig. 2).

To ameliorate the situation, pavement renovation is sometimes undertaken to enlarge the space or opening at the root crown. It would be comparatively simple to remove paving blocks in areas with flexible paving. However, in locations with inflexible concrete pavement and / or kerbs around tree pits or planters, when the rigid concrete is removed, the sudden loss of the support provided by the hard surface could lead to toppling of trees. It is therefore important to plan ahead for the works, assess the site situation and stability of the trees, provide additional support as appropriate before the works commence, and implement the work with personnel of suitable expertise under proper supervision.



Fig. 1 The tree roots grow along hard surface



Fig. 2 Pavement lifting caused by root growth

#### **4. Lessons Learnt from Past Incidents**

##### **4.1 Case 1**

A *Ficus microcarpa* (Chinese Banyan) collapsed after removing the adjacent concrete paving (Fig. 3). It was revealed that the concrete tree pit and the structural roots were bound together. There was no additional support provided to the tree before the removal of paving.



Fig. 3 *Ficus microcarpa* collapsed during repaving

#### 4.2 Case 2

Another *Ficus microcarpa* (Chinese Banyan) collapsed during tree pit enlargement works when the surrounding pavement around the tree pit was removed (Fig. 4).



Fig. 4 *Ficus microcarpa* collapsed during tree pit enlargement works

Both trees in the above cases grew in small tree pits and most roots were confined in the small, restricted growing space. The rather large trees with wide crown spread had inadequate anchorage. The concrete rims of the tree pits were held in place by the adjacent rigid concrete paving, and in turn provided support to the trees. Once the concrete paving adjacent to the trees was removed, the sudden loss of the support induced the collapse.

## **5. Precautionary Measures for Renovation / Works or Removal of existing hard surface around trees**

For trees growing in confined pits surrounded by rigid hard paving instead of flexible paving, the stability of the tree may be adversely affected if the hard surface is removed suddenly. The following precautionary measures are recommended:

### **(i) Planning**

It is necessary to plan ahead before works. The site situation and condition of the tree including the pattern and distribution of roots should be checked. The rigid paving material such as *in-situ* concrete surrounding the trunk base might have provided some degree of support to the tree. Therefore the potential effect of the works on the stability of the tree has to be assessed. The extent of the work may have to be adjusted accordingly. Contractors should employ competent personnel with arboricultural knowledge to plan and implement works around trees. Site supervisory staff involved should also be trained and briefed of the precautionary measures.

The need of a permanent and robust support system should also be considered in the long run in particular for trees with large canopies and have been confined in restricted tree pits with rigid paving for a prolonged period.

(ii) Temporary support

Proper temporary support by means of either staking, guying or propping should be provided before commencing the works. The temporary support may be removed subsequent to the work after the stability of the tree is ascertained.

(iii) Site work and supervision

It is advisable to hand dig the hard surface, instead of using machinery, in phases around a tree. After the removal of hard surface, if soil backfilling or mulching cannot be arranged immediately, exposed roots should be covered by clean and moist hessian to prevent desiccation and to protect the roots from rapid temperature and moisture changes. No roots should be cut without the supervision of personnel with arboricultural knowledge.

## **6. Other Recommended Practices**

For long term healthy growth of trees in paved area, the following practices are recommended:

(i) Design for sufficient space for tree growth

For the healthy growth of trees in the long run, providing a planting area with sufficient space for tree roots to grow is generally preferable to growing trees in pits with limited space (Fig. 5).



Fig. 5a & 5b Healthy tree growth in planting strips

In situations with site constraints, and tree pits or planters are used, their sizes should be maximized as far as practicable to allow sufficient space and drainage for tree growth. Several tree pits can be joined together to form a larger planting area.

Adjacent paving design is also important for providing a desirable environment for tree growth, keeping the tree in good health condition, and avoiding future maintenance problems. In general, a tree should not be surrounded by concrete around the root collar (Fig. 6). Sufficient space should be allowed at the base of trees (Fig. 7). Permeable paving which allows penetration of air and water in general is recommended.



Fig. 6 A bad example showing a tree surrounded by concrete around the root collar



Fig. 7 Adequate unsealed space around the base of trees

(ii) Right tree for the right place

Choosing the right tree to match a particular site is the fundamental principle of tree selection. Sufficient space both above and below ground has to be provided for the ultimate size of trees. Large canopy trees are suitable for a site that have sufficient space for the mature size of the trees and are not appropriate for narrow pavements. Trees with aggressive roots / buttress roots such as *Ficus* species are in general not suitable for planting in confined tree pits (Fig. 8) and along narrow pavements.



Fig. 8 Trees with aggressive roots in confined tree pits

(iii) Adequate unsealed space around the base of trees

Adequate unsealed space should be provided around the base of trees for infiltration of water and air into the root zone.

(iv) Expandable tree grilles

Expandable tree grilles with adjustable panels or flexible and permeable paver blocks on sand base (Fig. 9) that can be easily removed / adjusted to allow for growth of trees should be used. They should be adjusted in a timely manner.



Fig. 9 Permeable paver blocks on sand base

(v) Soil corridor / Soil vault

The use of soil corridor and soil vault may also be considered to provide adequate soil volume underneath the pavement for healthy growth of trees.

(vi) Soil Quality

In general, it is necessary to ensure that the soil composition and quality in the planting area are suitable for tree growth. Soil may be ameliorated as appropriate before planting.

## 7. References

- 1) Gilman, E. F. 1997. *Trees for urban and suburban landscapes*. Delmar Publishers, Albany, the U.S.A.
- 2) Harris, R. W., Clark, J. R., Matheny, N. P., 2003 *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines* (4th Edition), Prentice Hall, the U.S.A.
- 3) Harris, R. W., Leiser, A. T., and Davis, W. R. 1974. 'Staking Landscape Trees'. *Arborist's News*, the U.S.A. 39(10): 157-161
- 4) Jim, C.Y. 1998. 'Pressure on urban trees: pervasive problem and possible amelioration'. *Arboricultural Journal* (Arboricultural Association, Dorchester, UK) 22(1): 37-60
- 5) Neely, D. Watson, G.W. (ed) *The Landscape Below Ground I*, 1994, International Society of Arboriculture, Champaign, Illinois, the U.S.A.
- 6) Neely, D. Watson, G.W. (ed) *The Landscape Below Ground II*, 1998, International Society of Arboriculture, Champaign, Illinois, the U.S.A.

- 7) Urban, J., 2008. *Up by Roots: Healthy Soils and Trees in the Built Environment*, International Society of Arboriculture, the U.S.A.
- 8) Watson, G.W. Costello, L., Scharenbroach, B., Gilman, 2009. *The Landscape Below Ground III*, 2009, International Society of Arboriculture, Champaign, Illinois, the U.S.A.
- 9) Watson, G.W. and E.B. Himelick. 2005. *Best Management Practices: Tree Planting*. International Society of Arboriculture, Champaign, Illinois, the U.S.A.