

ESTIMATING THE WEIGHT OF BRANCHES, TREES AND ROOTBALLS

1. Formula for estimating above-ground weight of tree during the growing season

Notes

- i) Tree weight during the growing season declines by up to a third during dormancy
- ii) Equation 1 was found by field experimentation described in:
'A relationship between circumference and weight in trees and its bearing on branching angles'
Murray, Cecil D., Journal of General Physiology, May 1927, pp. 725 – 729
- iii) The limit of research is such that use of Equation 1 for trees exceeding 18cm stem diameter assumes an extrapolation of the logarithmic relationship (found experimentally below this size) between circumference and weight

Equation 1 – Approximation for above-ground weight of tree during the growing season

$$W \approx 7.08 C^{2.49}$$

Where:

- W is weight in grams: divide by 1000 for Kg and 1000000 for tonnes
 C is the maximum* stem circumference in cm
 D is stem diameter in centimetres

* Excluding spheroblastic or other essentially irrelevant localised distortions

2. Formula for estimating weight of rootball where trees are proposed for relocation:

Underlying equations:

Equation 2 – Volume of the rootball

$$V_R = \pi D_R^2 L$$

Where:

- V_R is volume of rootball in m^3
 D_S is stem diameter in cm
 L is rootball depth (at least 1m)

Equation 3 – Approximation for diameter of rootball required to sustain the tree

$$D_R \approx 10 D_S$$

Where:

- D_R is the required diameter of the rootball in m
 D_S is diameter of stem in cm

Equation 4 – Approximation for weight of rootball for lifting

$$W_R \approx 2V_R$$

Where:

W_R is weight of rootball in tonnes, approximated to 2T per m^3 of volume (mainly soil)

V_R is volume of rootball in m^3

Equations 2 – 4 combine to produce:

Equation 5 – Approximation for weight of required rootball as a function of stem diameter

$$W_R \approx 50\pi D_s^2 L$$

Where:

W_R is weight of rootball in tonnes

D_s is diameter of stem in m

L is rootball depth (at least 1m)

The total weight of the tree during the growing season + its rootball is thus the sum of Equations 1 and 5

3. Worked example for a tree of 80cm (0.8m) stem dia

Weight of tree (during growing season) in grams and tonnes where D_s is 80cm:

$$W \approx 7.08 C^{2.49}$$

$$C = \pi \times 80 = 251.20$$

$$W = 7.08 \times 251.20^{2.49}$$

$$W = 7.08 \times 946343.69$$

$$W = 6,700,113.3 / 1000000 = 6.7 \text{ tonnes (to one SF)}$$

Weight of rootball in tonnes where D_s is 0.8m and L is taken as 1:

$$W_R \approx 50\pi D_s^2 L$$

$$W_R = 50\pi \times 0.8^2 \times 1$$

$$W_R = 157.1 \times 0.64$$

$$W_R = 100.54$$

Total weight of tree to be lifted is thus (Eq1 + Eq5) 107 T (rounded)