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 m³
- \( D_R \) is stem diameter in cm
- \( L \) is rootball depth (at least 1m)

Equation 3 – Approximation for diameter of rootball required to sustain the tree
\[ D_R \approx 10D_S \]

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
\[ W_R \approx 50\pi D_s^2L \]

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:

\[ W = 7.08 \cdot C^{2.49} \]

\[ C = \pi \times 80 = 251.20 \]
\[ W = 7.08 \times 251.20^{2.49} \]
\[ W = 7.08 \times 946343.69 \]
\[ W = 6,700,113.3 \div 1000000 = 6.7 \text{ tonnes (to one SF)} \]

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

\[ W_R = 50\pi D_s^2L \]

\[ W_R = 50\pi \times 0.8^2 \times 1 \]
\[ W_R = 157.1 \times 0.64 \]
\[ W_R = 100.54 \]

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