Chapter 5

Incremental stem diameter growth results applied to tree grids and tree rings used in the landscape architectural industry

Note: This chapter is intended for publication in the Urban Green File.

Tree grids and tree rings pose certain challenges to the designer of landscapes especially those designing hard landscapes like roads, parking areas and pavements. Two main challenges are tree stem growth and lateral root growth. Figure 5.1 illustrates how the stem growth of *Celtis africana* trees in the City of Tshwane has exceeded the growth space provided by tree rings and has caused damage to both the rings and the trees. This situation could possibly have been prevented if the designer or urban forester had knowledge of the sizes that tree stems reach at certain ages. There is little quantitative knowledge in South Africa relating to tree stem size in relation to the age of indigenous trees. This could lead to inappropriate use of tree rings and tree grids.

One of the main reasons why knowledge about stem growth rate for South African indigenous trees is lacking is because many indigenous trees have been cultivated, domesticated and introduced to local markets over recent decades and the physical growth characteristics of these new-fashioned trees have not yet been studied and published. Apart from the lack of knowledge about the growth rate

characteristics of indigenous trees one also needs to bear in mind that urban forests have been established in more or less the last 150 years in the City of Tshwane. One hundred and fifty years are in some instances less than the maximum age that indigenous trees planted in the city could attain. Unlike European and Middle Eastern urban forests there has therefore been less possibilities and opportunities to study and obtain information about South African urban forests and in particular the more recently domesticated indigenous urban forest species (Konijnendijk, 2000). This chapter therefore has as its specific aim to provide the architecture, landscape architecture and urban forestry industry with quantified relationships between stem diameter size and tree age values, which directly relate to tree grids and rings.

The indigenous trees to be discussed are *Combretum erythrophyllum*, *Rhus lancea* and *Rhus pendulina*. The oldest data available for the trees were 47.50 years 32.50 years and 15.50 years respectively. The restricted ages and hence restricted stem diameter ranges of the trees are due to the urban forest limitations alluded to above. What furthermore limited the ages and hence the stem diameter sizes were the fact that the City of Tshwane Metropolitan Municipality has only focused on indigenous street tree plantings since the middle 1990s. This rendered limitations as to the oldest street trees obtainable for inclusion in the data sets and hence two sets of parking lot trees were incorporated for *Rhus lancea* and *Rhus pendulina* in an attempt to widen the age and stem diameter range.

The methodology and statistical procedure of obtaining the stem diameter to age relationships have been discussed in Chapter 2 and Chapter 3. Two

manufacturers of tree grids and tree rings were consulted for this study. They are Townscapes manufacturing the “Baltimore Tree Grids” (grids) made of cast iron (Figure 5.2) and Vanstone producing the “Pavement Tree Rings” (rings) of concrete (Figure 5.3). The grids are manufactured with inner diameters of 300 mm, 460 mm, 600 mm, and 800 mm while rings are produced with inside diameters of 460 mm, 550 mm, and 610 mm (Table 5.1). Although not all the various tree grid sizes are currently in production they will still be used in this discussion.

Table 5.1 shows the estimated mean tree ages at which the various species’ stem circumferences will exceed the inner diameter of the specific grid or ring. The 800 mm diameter grid provides sufficient growth space for approximately 38 years’ growth for a *Combretum erythrophyllum* tree. Few landscapes are, however, designed to have such a short life span, therefore using a grid or ring that limits growth beyond a certain age will be short sighted. Table 5.1, although still incomplete, gives some indication as to the time of unhampered tree growth within the grids and rings for the three species. For certain environments it may be appropriate to envisage a landscape life time of only a few years. This will justify the use of smaller diameter rings and grids, which will save on project costs. Due to the difference in growth rates the following should be born in mind: If a grid of 300 mm diameter is used then *Combretum erythrophyllum*, *Rhus lancea* and *Rhus pendulina* will outgrow that diameter in approximately 10.75 years, 18.50 years and 15.75 years respectively.

(a)

(b)

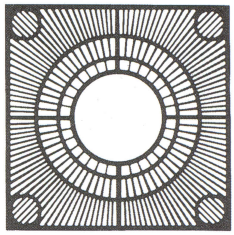
(c)

(d)

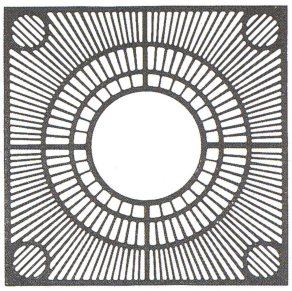
Figure 5.1. Tree rings are broken in (a) and (b) due to a *Celtis africana*'s lateral stem growth and basal stem swelling, whilst in (c) tree ring impedes stem growth, and in (d) surface lateral root growth damages a tree ring as can be seen on the right hand side of the tree ring.

Townscape - TREE ACCESSORIES

Baltimore Tree Grid

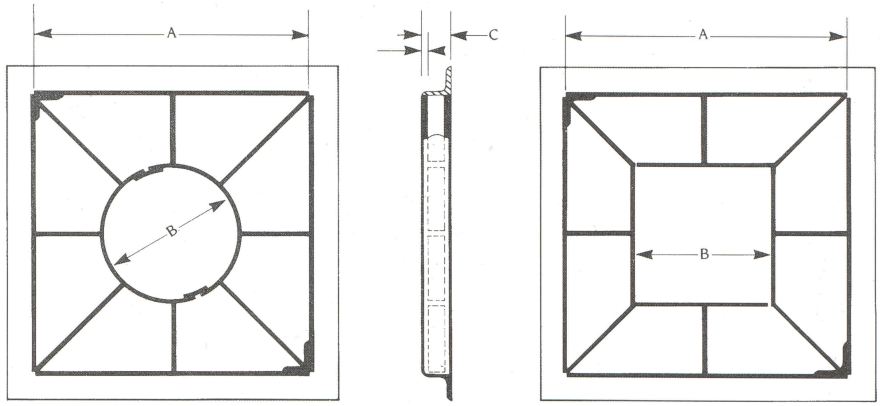


Baltimore 1200



Baltimore 1500

The Baltimore 1200 x 1200mm is supplied in two sections, but the 1500 x 1500mm is supplied in four sections.



PAVING AND GRID SUPPORT FRAME

To select the correct size of paving and tree grid support frame, first determine:

1. Depth of paving.
2. Overall size of support; and
3. Type of grid to be supported.

The internal square or hole 'B' may be reduced by an additional inner support frame.

The paving support angle size 'C' can be made suitable for any depth of paving and the height of the internal framework 'D' can be altered to suit the thickness of grid.

Lugs may be fitted for the attachment of a tree guard and also for the security locking of grids to prevent their unauthorised removal.

A	B	C	D
456 x 456	300	75 x 50	40
606 x 606	300	75 x 50	40
1025 x 1025	360	100 x 100	25
1210 x 1210	460	100 x 100	25
1510 x 1510	600	100 x 100	25
1820 x 1820	800	100 x 100	25

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Figure 5.2. Townscape Baltimore Tree Grid

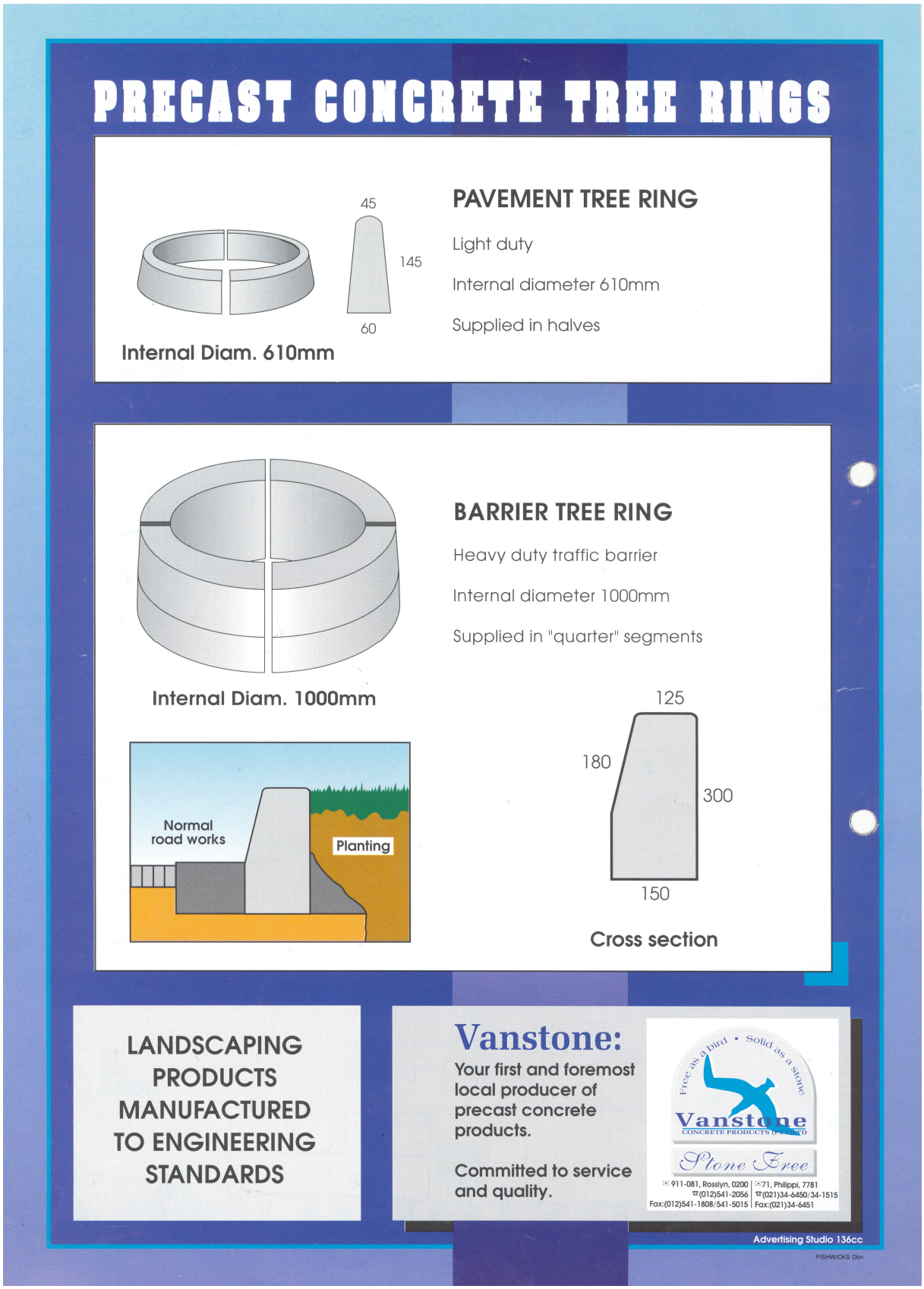

Figure 5.3. Vanstone Pavement Tree Ring

Table 5.1. This table shows the mean estimated tree age of three indigenous street tree species in the City of Tshwane at which their stem diameter will exceed the inner diameter of both the Baltimore Tree Grids and the Pavement Tree Rings

Species	**Baltimore Tree Grids**				**Pavement Tree Rings**		
	300 mm ϕ	460 mm ϕ	600 mm ϕ	800 mm ϕ	460 mm ϕ	550 mm ϕ	610mm ϕ
Combretum erythrophyllum	10.75 yr	17.75 yr	25.25 yr	38.25 yr	17.25 yr	22.50 yr	25.75 yr
Rhus lancea	18.50 yr	33.00 yr*#	-**	-**	33.00 yr*#	-**	-**
Rhus pendulina	15.75 yr*	-**	-**	-**	-**	-**	-**

ϕ Inside diameter of tree grids and tree rings
yr Age of tree in years
* Marginally extrapolated beyond the data range
# Upper confidence interval used
** No data available

This suggests that it would be inappropriate to use the 300 mm diameter grid for all three the species if they were used in a landscape with a life expectancy of, for example, 15 years but would on the other hand be appropriate if the landscape life expectancy is 10 years or less. This implies that species specific tree rings and grids need to be chosen when designing landscapes, which in turn necessitates species specific knowledge of stem diameter growth to age relationships.

The tree ages in Table 5.1 are estimates based on statistical calculations and should not be viewed as absolutes but rather as approximations. Furthermore, the growth rates of trees may increase with higher managed irrigation and fertilization practices and these are not accounted for in the data set on which the results are based. When considering highly managed (regularly irrigated and fertilized) trees, the results in Table 5.1 may be viewed as conservative. This study did not consider the growth of surface lateral roots that may damage or be restricted by tree grids and rings. Often these lateral roots may become problematic to these landscape elements before the actual stem growth is impeded.

When considering long-term landscapes it should be recognised that trees like *Combretum erythrophyllum* and *Rhus lancea* have life expectancies of approximately 100 years and more than 200 years respectively (A.E. van Wyk, personal communication, Department of Botany, University of Pretoria, City of Tshwane, South Africa). It is therefore advised that architects, landscape architects and urban foresters should choose the appropriate tree grid or ring for

the expected lifetime of a project or if budgets are constrained, to choose the appropriate tree so that suitably smaller tree rings and grids can be used.

References

Konijnendijk, C.C. (2000). Adapting forestry to urban demands – role of communication in urban forestry in Europe. *Landscape and Urban Planning*, **52:** 89-100.

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