RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Preventing Damage to Trees From Grade Changes

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During building or landscape construction, the grade of the land frequently is altered to form a more level site. Grade changes made near trees will seriously disturb the delicate relationship between roots and the surrounding soil. This results in root mortality, decline in vigor and frequently, death of the tree.

Symptoms of Damage

Symptoms of damage from grade changes can appear as a progressive decline of the crown, which occurs over a period of several months to several years. Initial symptoms generally include delayed budbreak, reduced growth, stunted light green to yellow leaves, crown thinness, and premature fall coloration and leaf abscission. Epicormic sprouts might form on the trunk and large limbs and twig dieback may occur. This may be followed by dieback of large branches and entire leaders and finally, tree death.

The severity of the symptoms and the rate at which the tree declines depend on the extent of the grade change, any associated soil and root disturbances, and the age, size and initial vigor of the tree and the species. If root damage is severe, tree mortality can result within one year. If grade changes are slight, young vigorous trees might tolerate the disturbance and exhibit few symptoms. Generally, mature or over-mature trees, those in a weakened condition, and shallow-rooted species are most sensitive to grade changes.

Evidence of grade changes also can be detected near the base of the tree. Most healthy trees exhibit a flare (widening) at the base of the trunk. Where soil or other fill has been added over the root system to raise the grade, little or no flare is present on the trunk (Figure 1). Where soil has been removed to lower the grade, abrupt changes in the normal grade of the land may be detected. In some instances, trees may appear to be growing on small, raised beds or mounds and buttress roots may be exposed, unless backfilled (Figure 2).

Figure 1: Soil fill and turf up to base of tree. Note lack of flare at base of trunk.

Figure 2: Grade change around tree

Figure 3: Root and soil disturbance

Effects of Grade Changes

Lowering the grade near trees causes root destruction, which reduces the water and nutrient absorption capability of the tree and reduces its structural integrity. Fine or feeder roots, which are responsible for water and nutrient absorption, occur primarily within the upper six to eight inches of soil. Lowering the grade by only a few inches will cause extensive fine root destruction. Drastic grade reductions may destroy large support roots, which can predispose trees to windthrow during storms.

Raising the grade near trees essentially suffocates roots. Like all plant cells, root cells respire; that is, they utilize oxygen and give off carbon dioxide (CO2). Oxygen and CO_2 exchange occurs between tree roots and pores within the surrounding soil. The addition of fill compacts the soil thereby reducing the amount of pore space. Proper gaseous exchange between the roots and surrounding soil is inhibited, which results in root suffocation (Figure 3).

The extent of tree damage from raising the grade depends largely on the depth of the fill and the soil type. The deeper the fill, the more extensive the root destruction will be. Fill composed of sandy soil, which is very porous, will affect trees much less than fill composed of heavy clay soil.

Raising and lowering the grade also can affect trees by altering the water table. The addition of fill causes the water table to rise, which may result in flooding and subsequently, suffocation of the root system if the water table is initially very high. Lowering the grade will cause the water table to fall, which may reduce the amount of water available to the tree.

Preventing Damage from Grade Changes

Preventing tree damage from grade changes must be undertaken before the grade of the land is actually altered. Trees that are seriously declining due to grade changes seldom respond to corrective measures designed to save them.

Raising the Grade: Most young, vigorous trees can tolerate shallow fills of up to four inches if the fill is sandy. The same amount of clay fill, however, usually causes tree decline. Certain species, however, such as beech, yellow poplar, pines, and dogwood are very sensitive to even small amounts of a sandy fill. Developers and landscapers should consult a competent arborist before placing even shallow fills over tree root systems.

If more than a few inches of fill must be placed over tree roots, a well and drainage system must be installed. Figures 4 and 5 show the proper method of constructing a dry well and drainage system around a tree. The dry well must be large enough to allow for future growth of the trunk. Four to six inch agricultural drain tile should be placed on the natural

grade of the land. The tile should drain to a lower level to prevent water from collecting within the well. Cover the tile with six to eight inches of two- to three-inch stone. Do not use limestone because this will raise the soil pH and could adversely affect tree growth. Connect vent tiles with drain tile to allow for gaseous exchange between the root zone and atmosphere. The fill should consist of a sandy soil, including biochar as organic matter, in order to allow maximum aeration of the root zone.

Figure 4: Side view showing proper construction of well and drainage system for use around trees where soil fill has been added to raise grade.

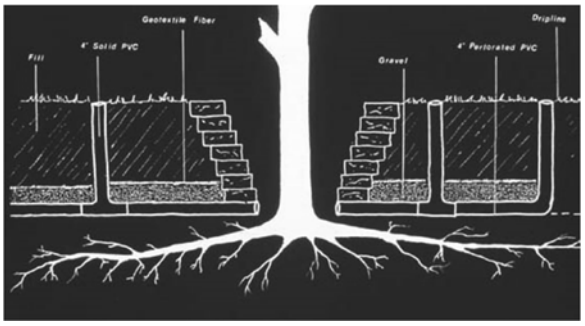
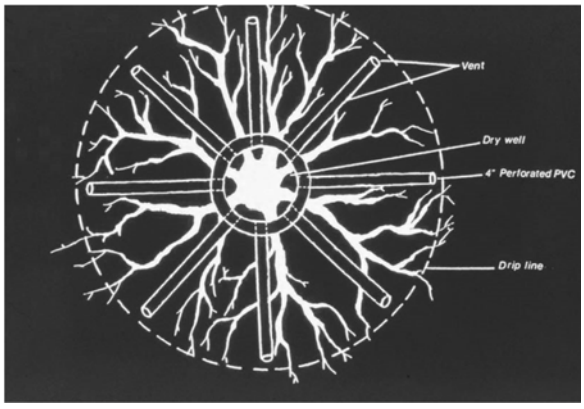
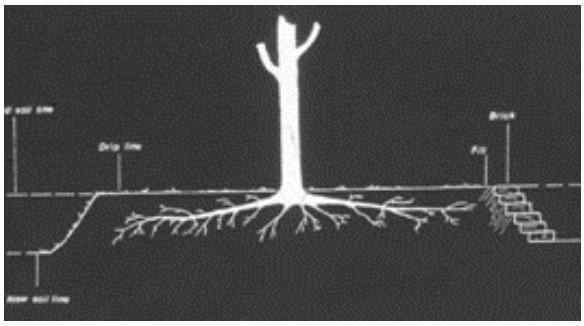


Figure 5: Top view showing proper construction of well and drainage system for use around trees where soil fill has been added to raise grade.



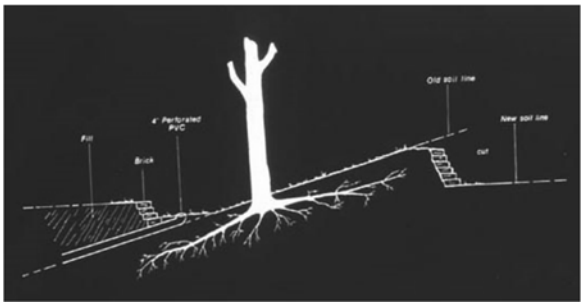
Lowering the Grade: All cuts in the natural grade must be made outside the dripline of a tree. Figure 6 shows the proper method of lowering the grade around trees.

Figure 6: Side view showing proper method of lowering grade near trees.



Raising and Lowering the Grade: Where trees are growing on a slope, the landscape sometimes is cut and filled in order to create a level site. Figure 7 illustrates the proper method of raising and lowering the grade around trees. Again, all grade changes should be made outside the dripline of the tree. Specification for the drain tile and fill soil are the same as those outlined previously.

Figure 7: Side view showing proper method of raising and lowering the grade around trees.



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