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Training & Education: Climbing System Forces

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Tree care professionals often spend a great deal of time and energy evaluating the safety, strength, and security of their tie-in point (TIP), and rightfully so, as their lives literally depend on it. But often ignored or overlooked in TIP evaluation are the forces to which the TIP is exposed as a result of the individual climber's chosen ascent or climbing system.

The majority of climbing arborists are accustomed to looking at the strength and safety of their TIP through the lens of a dynamic climbing system -- in which their weight is shared between both parts of the rope, and both parts of which move when ascending or descending. However, these same climbers may use a completely different system to ascend to the beginning of their work in the canopy, and different systems are often accompanied by radically different forces on the TIP, which, in turn, can lead to the TIP's failure.

Other tree care professionals may have been exposed to newer systems they find more efficient or easier, and have made the switch without considering how their TIP might be adversely affected. In either case, a small amount of knowledge about the forces generated by different climbing systems can help climbers make better and safer choices about which branch or crotch is an appropriate TIP.

*** Dynamic Systems:** A dynamic system -- one in which both parts of the rope move and are attached to the climber -- exerts fairly straightforward forces on the TIP. Each part of the line bears approximately half the user's bodyweight, dependent on friction at the TIP, thus the TIP experiences the force exerted by the user's body weight. This force will obviously increase if the climber drops or bounces in the system due to the effect of gravity on their mass -- yet another reason to try to maintain as little slack as possible in the system in the event of a slip or misstep. In a bid to minimize friction at the TIP, some climbers choose to have their climbing line in a dynamic system running through a pulley in a variety of configurations. The use of a pulley -- such as in the ART Rope Guide or a sling/appropriately rated separate pulley combination -- in this manner does not dramatically change the forces experienced by the TIP, and it still experiences approximately the user's body weight (excluding drops or bounces into the system). However, the use of a separate line to suspend the pulley does change the TIP forces. If the climber's dynamic system is set up to run through a pulley attached to one end of a rope while the other end of the rope runs over a branch and down to an anchor point on the ground or trunk, then the user has effectively doubled the amount of force that branch is experiencing. Closely examining the system illustrates this: the pulley is experiencing the force of the climber's bodyweight and movements within the system in a downward direction on the branch, the anchored part of the line must exert just as much force in a downward direction on the branch in order for the pulley to stay aloft, thus the branch sees twice the force of the climber's bodyweight and movements within the system.

*** Static Systems:** Similarly to a dynamic system, a static system -- where both parts of the line go over a branch but do not move, and both parts of the line are loaded with the climber's body weight -- will produce forces at the TIP roughly equal to the climber's body weight (exclusive of drops or bounces on the system). However, climbing on a single part of the rope with the other part anchored at the ground or base of the tree will once again double the forces experienced by the TIP. This does not mean single rope technique (SRT) is unsafe, but rather that users must examine their TIP through the proper lens of the system they will be employing. Additionally, SRT climbers may use a running bowline or alpine butterfly to choke the rope off to the branch -- once again returning the forces to simply the user's bodyweight and their movements.

Hopefully, this admittedly basic primer on some of the forces generated by various climbing systems at the TIP will help climbing arborists look more closely at how changing systems can also change forces, sometimes with catastrophic results; and assist them in using the right "lens" when they look at a potential TIP.


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