

## **Baskets versus the Basket+, equivalence of strengths.**

Roger Mortimer, David Angel

### Abstract

Previous testing has shown that a basket hitch is stronger than a wrap 3, pull 2 anchor during slow pull testing. The difficulty of webbing to adjust may explain this difference. A basket hitch is quick to place but will slip down whatever it is tied on. It is tempting to add an extra wrap around the anchor object so it will stay in place, but this may introduce weakness if the anchor now has difficulty adjusting once under load. We looked to see if there was a difference in breaking strength between a basket hitch and a plain basket hitch and one with an extra wrap (basket+).

Testing was done at CMC industries in Goleta, CA using a hydraulic ram and a load cell. Anchors were tied in 1 inch tubular webbing around a 4 inch diameter bollard with an Omega Pacific steel carabiner on the load side. Webbing lengths were 70 inches for the basket and 98 inches for the basket+ so that each anchor would have the same angles between arms. Webbing was cut sequentially from the same spool. Each anchor was loaded to 1 kN then the length of the arm was measured to ensure consistency and to see that the webbing was seated well in the carabiner. After verification the anchor was tested to destruction at a rate of 8 inches per minute. Force was measured 20 times per second. A first set of 20 was done dry and then a second set of 10 was done after soaking in water for 3 hours.

Average strength in the dry basket was 8792 lbf  $\pm$ 639 giving a MBS of 6875 versus, for the dry basket+, 8786 lbf  $\pm$ 839 for a MBS of 6269 (not significant). In the wet webbing the basket failed at 8789 lbf  $\pm$  765 (MBS 6494) versus 8295 lbf  $\pm$  771 (MBS 5982) (not significant). Combining groups, there was no significant difference between wet and dry. All anchors broke at the carabiner. All were single breaks except for one single double break. None broke at the knot, though it was always in an arm and never protected against the bollard. All breaks happened at the inside loop of webbing on the load side.

We found no difference in anchor strength between the basket and the basket+. There was no significant difference between the dry webbing and the wet webbing. The knot is not the weak point in the anchor. It can be placed anywhere convenient, though it may still be best to place it in a protected spot for ease of untying. Water made no significant strength reduction. Both are stronger than knotted 11mm nylon rope. Since failure happens universally at the carabiner, increasing strength further would require changing the interface at the carabiner.