Abstract:
Main-Belay and Two Tensioned Rope Systems have been tested to compare their survival during a failure at an edge transition. No work has been done to test which is better during an uncontrolled horizontal movement at any time where the load is below the edge transition. Some “quick-look style” testing was done using a 200kg test mass and a 2m granite edge with both M-B and TTRS. In 10 tests no clear difference was found.

Introduction:
Over the last few years, there has been much discussion in Technical Rescue circles over the merits of Two Tensioned Rope Systems (TTRS) versus Main and Belay (M-B) systems and the various merits and drawbacks of each system. The British Columbia Council for Technical Rescue (BCCTR) style drop test where a 200kg mass is dropped 1m with 3m of rope in service is the current gold standard for testing system suitability as it represents a worst case scenario of a line or anchor failure during an edge transition. TTRS has shown better survivability during BCCTR drop testing on a sharp metal edge (Mauthner, 2014) using both TTRS and M-B systems. However, it has also been shown that M-B systems can have equivalent survivability to TTRS in the same tests if the ropes in service are adequately protected (Gibbs 2015). While much effort has been expended on the BCCTR style drop tests relatively little has been done to test whether TTRS or M-B systems perform better in an uncontrolled horizontal movement over an edge. Forbes (2015) evaluated the result of uncontrolled horizontal movements across an edge using a variety of ropes but with only one rope in service. With TTRS, during uncontrolled horizontal movements across an edge, it would be expected that both ropes would suffer damage proportional to the load on each line. With M-B, it would be expected that the Main line would suffer much damage and the Belay none.

Materials and Methods:
A 200kg mass, composed of two sets of 5 20kg sandbags each inside a larger protective sack, was suspended from a tree approximately 5m from the test edge. The test setup was done using a 200kg test mass and a 2m granite edge with both M-B and TTRS. In 10 tests no clear difference was found.

Results:
A video of the tests is available on Youtube: https://youtu.be/-Cpo-gnPaEQ

Discussion:
This is only a quick-look style evaluation and should not be seen as a definitive study with definite conclusions however, what it is possible to ascertain is that: M-B systems survive an uncontrolled horizontal movement across an unprotected edge with sheath damage to the main line varying between moderate and complete, and no damage to the Belay. No damage was seen on the core strands of the rope. For TTRS the damage is distributed unevenly across both ropes seemingly irrespective of relative degree of loading of the ropes (every effort was made to load the ropes evenly), with sheath damage varying between negligible and total. No damage was seen on the core of the rope. With no completely cut through ropes and no available method of evaluating residual strength of the damaged rope it is simply not possible to decide which system performed better. The test edge’s lack of any particularly sharp crystals and wear caused by the testing may also have contributed to the lack of definitive outcomes. The Beal ACCESS UNICORE is a softer rope with a good hand and knotability while the Southern Rope is a much harder rope, with a poor hand. The harder rope seemed to perform a little better but as only one test per system was conducted with Southern Rope those results cannot possibly seen as representative.

Conclusion:
Rescue systems are far more robust than we think they are. Neither M-B nor TTRS can be selected as having performed better in our testing but they can both certainly survive what would be seen as a very catastrophic failure were it to occur during a rescue operation.

References:
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Figure 1: Sketch of test setup

Figure 2: Actual test setup