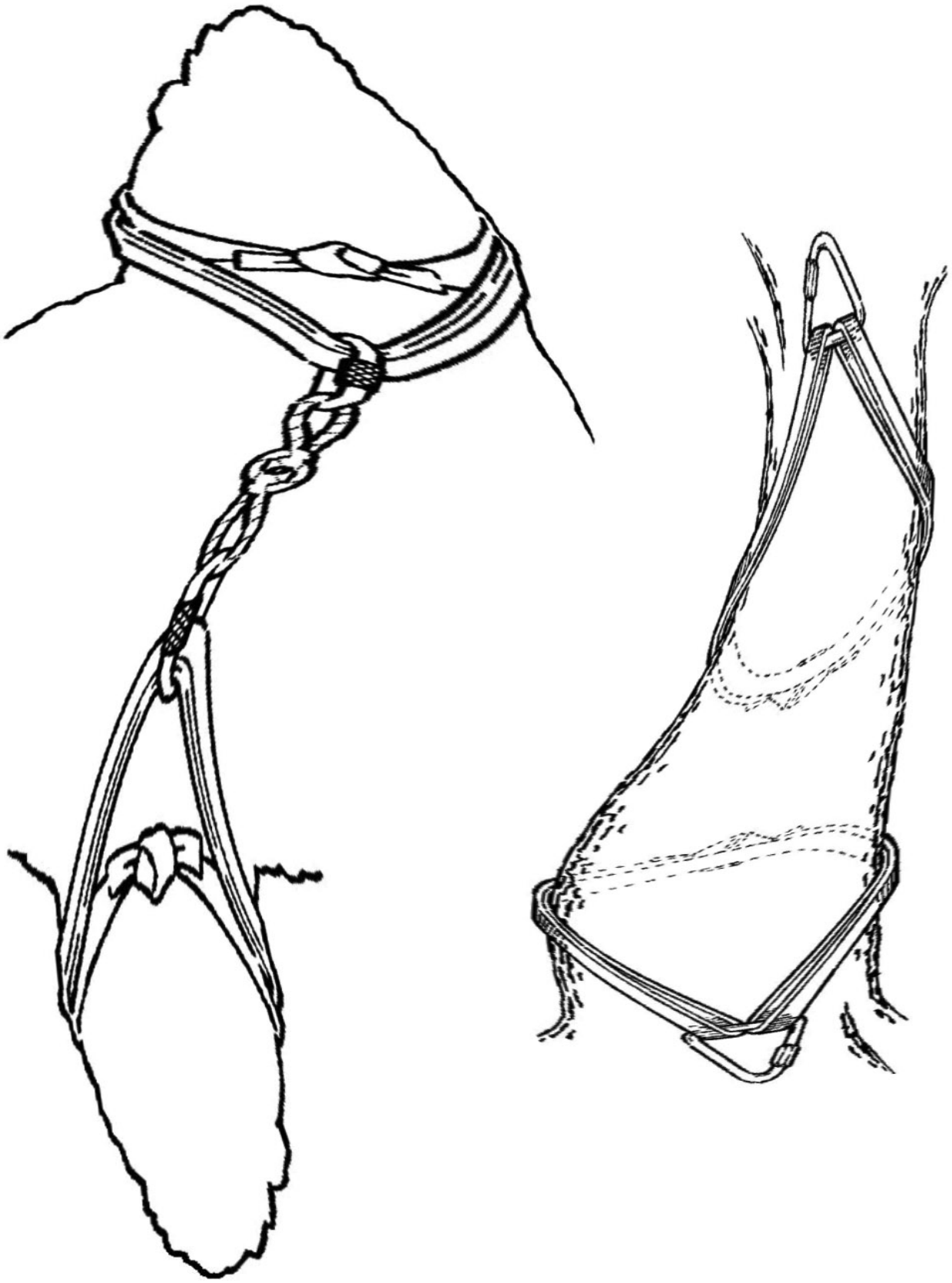
Nylon Highway

Issue #57



... especially for the Vertical Caver

#57

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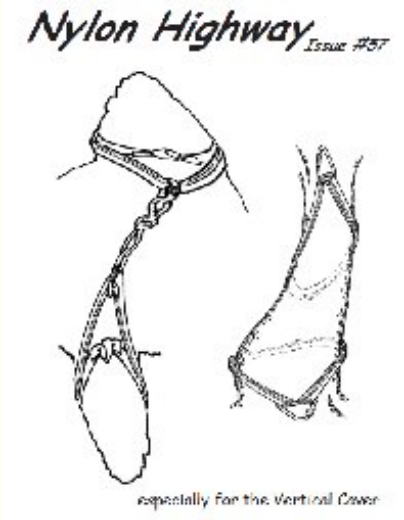

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Nylon Highway

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WARNING: The reader must acknowledge that caving, climbing, mountaineering, rappelling, rescue work and other rope activities expressed in the *Nylon Highway* are inherently dangerous activities and serious injury or death could result from use and/or misuse of techniques and equipment described in this publication.

Empirically Derived Breaking Strengths for Basket Hitches and Wrap Three Pull Two Webbing Anchors

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Introduction and Background:

All rope rescue systems have an anchor, and if the system is designed conservatively, the anchor should be stronger than the rest of the system (ideally the rope is the weakest point in the system). Consequently it is important to know the strengths of our anchors, as well as the relative strength of the anchors in different configurations. Copious pull tests and dynamic tests of anchors have been performed in the past however few of these testing programs have been published for a wider audience, and rarely are the conditions of the tests reported in sufficient detail for others to independently determine the validity and rigor of the testing programs. In addition, statistically significant numbers of tests are usually absent, meaning that the variability in anchor performance is nearly entirely unknown. The research program presented here is designed to measure the absolute breaking strength of two anchor types (basket hitches and wrap three pull two anchors (W3P2)), observe their relative strengths, the variability in breaking strengths and breakage patterns, and ultimately to ascertain if both are acceptable rescue anchors as expected.

Materials:

Two spools of new unused one inch PMI tubular webbing were used from lot number 45105 and loom 514. One of the two spools had a splice, and the splice point was not included in any of the anchors measured, though both sections of webbing on the full spool were given their own spool designation when sample numbers were assigned to each anchor. Measurements of breaking strengths were conducted on a Baldwin universal testing machine with DP41 digital load deflection upgrade electronics with an internal load cell range of 0 to 200,000 lbs, at the College of Engineering, Montana State University. The universal testing machine was last calibrated on 3/10/2011 and measurements took place on 6/23/2011–6/24/2011.

Methods:

Eight feet of webbing was used to tie basket hitches and nine feet was used for W3P2 anchors. To ensure no effect was observed due to the spool of webbing used, lengths of webbing were cut from each spool alternating between basket hitches and W3P2 anchors. Samples were given a unique sample number consisting of four parts; the spool number the webbing came from; type of anchor tied; the number of the piece of webbing along the length of a spool, and finally the test number. For example 3-B-14-28 corresponds to webbing from spool number three, a basket hitch was tied with it, it was the fourteenth length of webbing cut from spool three, and it was the twenty-eighth measurement performed. All anchors were tied by one person (A.S.) to retain consistency. Anchors were tied around a 4 inch diameter smooth steel pipe filled with concrete and the attachment point was a half inch diameter, four inch tall steel screw link purchased from a hardware store. Basket hitch knots were placed behind the metal pipe while the W3P2 knots were placed on the front of the pipe facing the load.

Each anchor was built and quickly loaded up to ~8000 lbs (~82 lbs per second) then the rate of loading was decreased (~14 lbs per second) till breakage occurred. All trials were photographed prior to initiation and recorded to create a permanent record of qualitative observations. The anchor internal angle was measured from anchor photographs. The number of

breaks each anchor experienced, as well as the kind of break (clean or a fray) was recorded in addition to any notes or abnormalities observed during measurement.

The measured raw breaking strengths were multiplied by the force multiplier determined by the internal angle of the anchor to calculate the load experienced by the anchor. This scaled data was used for all statistics. Descriptive statistics (average, maximum, minimum, range, and standard deviation) were calculated for all trials as well as a subset of those trails in which no abnormalities were observed. To test the null hypothesis that the two anchors had the same breaking strength a two-tailed Z-test was performed for all the data as well as the subset of tests in which no abnormalities were observed.

All anchors broken were saved and archived for later study and can be accessed by contacting the authors. In addition, copies of the electronic data (photographs, videos, and Excel files) can be provided upon request.

Results:

Basket hitches were tied with an internal angle of 15 degrees, yielding a force multiplier of 0.008628961, while W3P2 anchors had an internal angle of 12.5 degrees, yielding a force multiplier of 0.005979200. Table 1 displays the raw breaking strengths, scaled breaking strengths, number of breaks, breakage types (clean or fray), and notes and observations made during measurements.

Basket hitches (N=34) broke at an average load of 9943.2 lbs with a standard deviation of 642.4 lbs, with a maximum load of 11244.2 lbs, and a minimum of 8902.2 lbs. W3P2 anchors (N=35) broke at an average load of 9167.3 lbs with a standard deviation of 1075.4 lbs, with a maximum load of 11695.5 lbs, and a minimum of 7445.3 lbs. To test the null hypothesis that the two anchors broke at the same average strength, a two-tailed Z-test was performed yielding a P-value of .000212 (α=.05, critical value 1.959964), suggesting there is a statistically significant difference between the breaking strengths of the two anchor types. Figure 1 shows the breaking strengths of both basket hitches and W3P2 anchors versus rank order (lowest breaking strength to highest). The difference between the average breaking strengths between the two anchor types is visually observed through the gap between the two trends in breaking strengths.

All measurements shaded in grey in Table 1 had some abnormality during measurement, and were omitted to remove any effect the abnormalities may have had during data analysis. The same general trends were observed with this truncated (more conservative) data set. Basket hitches (N=27) broke at an average load of 9928.3 lbs with a standard deviation of 627.7 lbs, with a maximum load of 11208.9 lbs, and a minimum of 8902.2 lbs. W3P2 anchors (N=33) broke at an average load of 9221.6 lbs with a standard deviation of 1064.4 lbs, with a maximum load of 11695.5 lbs, and a minimum of 7455.3 lbs. The two-tailed Z-test yielded a P-value of .001494 (α=.05, critical value 1.959964), also suggesting there is a statistically significant difference between the breaking strengths of the two anchor types. Figure 2 shows the breaking strengths of both basket hitches and W3P2 anchors versus rank order (lowest breaking strength to highest). The difference between the average breaking strengths between the two anchor types is visually observed through the gap between the two trends in breaking strengths. Both Figures 1 and 2 show basically the same trends.

Observations

In all trials the anchors broke at the screw link and not at the knot, suggesting that the knots are not the weak point in the anchors in the configuration tested. Basket hitches tended to break at two locations simultaneously (24 times or 71%), while W3P2 anchors broke in two locations less frequently (8 times or 23%). In 4 trials (11%) one strand of a W3P2 anchor broke,

however the anchor held until pulled further since the loaded webbing held the anchor in place even with the severed strand. In addition, the W3P2 anchors made many more noises during loading than the basket hitches.

Figures 3 and 4 depict the breaking strengths of both basket hitches and W3P2 anchors versus rank order (lowest breaking strength to highest) with the spool of origin indicated for each test. Basket hitches show a roughly even distribution of spools throughout the rank order breaking strengths suggesting there is no effect due to the spool of origin in the breaking strengths. The opposite is true of W3P2 anchors with spool 3 anchors breaking at lower strengths than spool 1 anchors. Since statistically significant numbers of anchors of both types could not be made with each spool of webbing it is impossible to determine if this effect is real or a function of chance. Here we simply note that there appears to be a difference in the breaking strengths of W3P2 anchors between spools and acknowledge an insufficient sample size to determine if this effect is a function of chance or not.

Sources of Error:

All measurements have an associated error, in this case the error inherent in the Baldwin universal testing machine was as low as can be expected since it had been recently calibrated. More importantly, the error is on the order of plus or minus a few pounds. The error in cutting the lengths of webbing was on the order of a millimeter or two. The variability in tying hitches and their internal angles are the largest source of error in this suite of measurements. This variability was small enough that, when measured, the internal angles for each anchor type (basket hitch or W3P2) were consistently the same. Internal angle measurement error was on the order of half a degree. In toto the sources of error are small enough that the conclusions reached are not affected by their inherent uncertainty in measurement (error bar).

Conclusions:

1. Webbing anchors broke at lower strengths than expected. Assuming a ~4000 lb breaking strength for each strand, a 16,000 lb breaking strength estimate was generated.
2. As tied the weakest point in the anchors is not the knot but the webbing itself.
3. Webbing anchors can break in more than one location simultaneously during failure.
4. Basket hitches break, on average, at a higher strength and with less variability (smaller standard deviation) than W3P2 anchors.
5. Basket hitches appear to be between 705 to 775 lbs stronger than W3P2 anchors in the configuration tested.
6. The most common failure mechanism of basket hitches is breaking of webbing at two locations simultaneously while the most common failure mode of W3P2 anchors is the failure of one strand.
7. There is variability in the breaking strength of anchors between spools of webbing as well as within a spool of webbing.
8. Both basket hitches and W3P2 anchors are stronger than 11mm nylon rope (~6000 lbs) so both are acceptable rescue anchors when tied in the configuration tested here.
9. Developing and implementing a testing program is easier than expected and is possible for many individuals who live in proximity to a university with testing facilities.

Discussion:

When interpreting the findings presented here it is important to keep in mind that these results apply to anchors tied in the configuration tested. Our results have no bearing on basket hitches and W3P2 anchors with knots located in different places, a variable that should be investigated in the future.

Both anchor types demonstrated they are adequate for rescue systems however, both have strengths and weaknesses. Basket hitches are stronger, are tied faster, and use less webbing, however, they slip and move around more easily than a W3P2 anchor. W3P2 anchors are weaker (but strong enough), are slower to tie, use more webbing, but stay in place far better than basket hitches. Ultimately both anchor types are effective and useful in a rigger's tool belt of techniques to apply to different problems. Both should be used in rescue systems when their strengths are needed and their weaknesses can be mitigated.

The observations and measurements presented here are consistent with an inference of the mechanism of loading and failure that explains the relative strength difference between the two anchor types. This inference forms the core of a hypothesis (testable causal explanation) of how anchors load and break, however, this inference should be tested prior to being used as an explanation of how anchors work.

Inference of loading and breakage mechanism: As anchors are loaded each limb takes weight more or less equally until the material starts to stretch. At this point the limbs are weighted unequally since some limbs were shorter than others (even if it is only a small difference). If the difference between the forces applied to limbs is greater than the static friction of the webbing against the object it is wrapped around the anchor will slip and equalize the force on the limbs. Basket hitches have far less friction between the webbing and the object it is wrapped around since there is less contact between the two objects. Consequently basket hitches are able to distribute the load faster and at a lower threshold than W3P2 anchors. When basket hitches finally fail they fail simultaneously at two locations since the breaking strength of the webbing has been reached at essentially the same time throughout the anchor since it is approximately equally loaded. W3P2 anchors have far more friction between the webbing and the object they are wrapped around making it harder for the limbs to equalize. This creates an anchor that has unequally weighted limbs, and the limb with the greatest loading fails first, creating a break in only one place. This causal mechanism also explains the observation of hearing more sounds from W3P2 anchors during loading. The greater friction caused the W3P2 anchors to shift small distances more frequently during loading producing noises, ultimately yielding an anchor that was probably not fully equalized. To test this hypothesis the same suite of measurements could be performed, however, the steel pipe used could be covered with a coarse sand paper introducing more friction to the system. If this causal mechanism is correct, the breaking strengths of the basket hitches should be reduced and we would expect to see basket hitches breaking more frequently at one location and not two. W3P2 anchors should also break at a lower value, though the loss should be smaller than basket hitches, and they should fail at one location more frequently. In addition W3P2 anchors should make less noise during measurements than when broken using a smooth pipe.

This research program has demonstrated the value of utilizing statistically significant samples since the variability in breaking behavior and strength has suggested properties of how the materials are behaving during use. This information directly suggests hypotheses that can be tested in the future, as well as provides users with information that can be used to select anchors more appropriately for the rigging challenges they face.

Acknowledgements:

Dr. Mike Berry, College of Engineering, Montana State University provided access to the testing equipment and lab space necessary to complete this work. In addition Kate McDevitt demonstrated the setup and of the machinery. Cathy Lash provided invaluable help in cutting and labeling webbing strands, as well as providing food during and after testing.

Figure 1: Breaking Strength vs Rank Order for Basket Hitches and W3P2 Anchors (All Data)

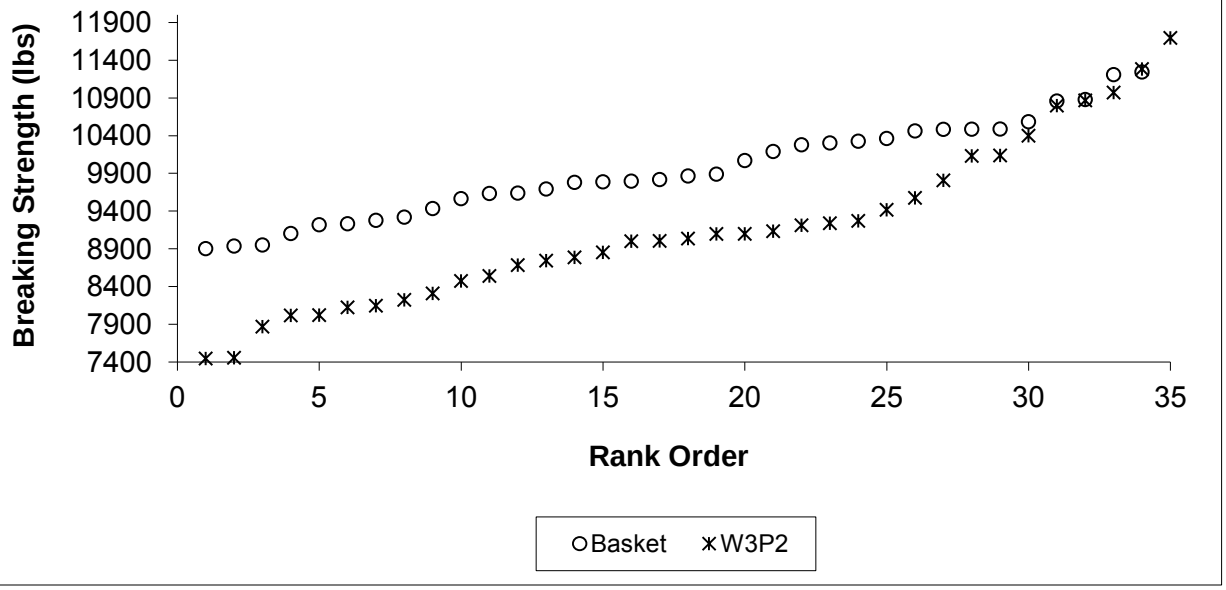

Figure 2: Breaking Strength vs Rank Order for Basket Hitches and W3P2 Anchors (Minus Abnormalities)

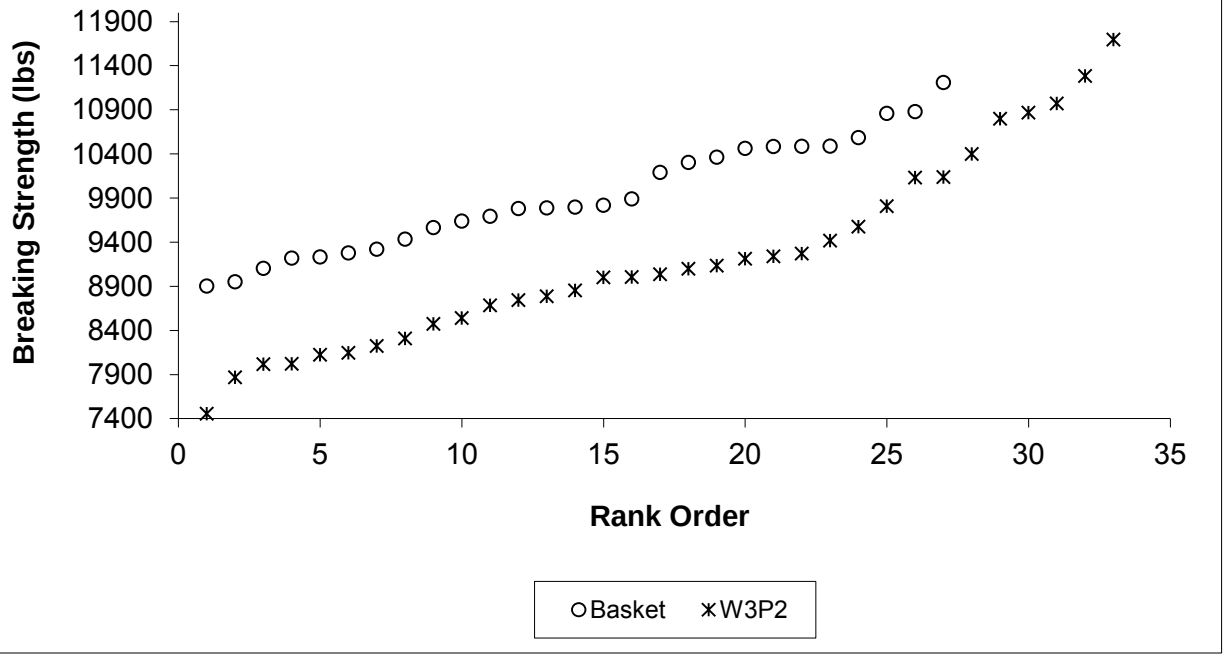

Figure 3: Breaking Strength vs Rank Order for Basket Hitches and W3P2 Anchors (All Data, Spools Colored)

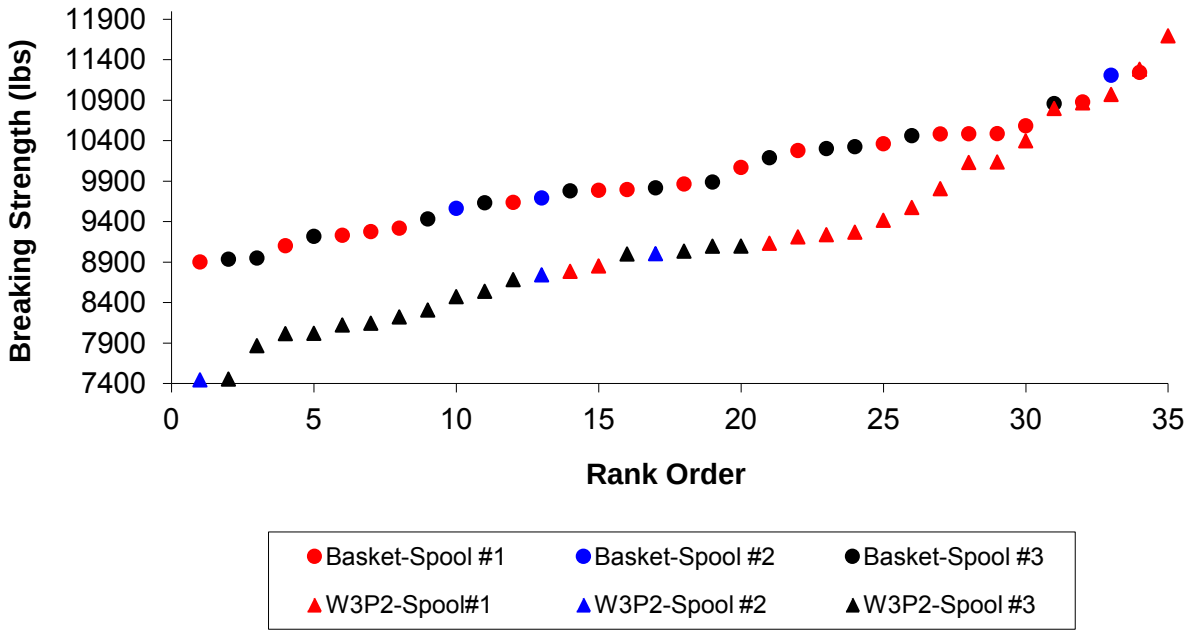

Figure 4: Breaking Strength vs Rank Order for Basket Hitches and W3P2 Anchors (Minus Abnormalities, Spools Colored)

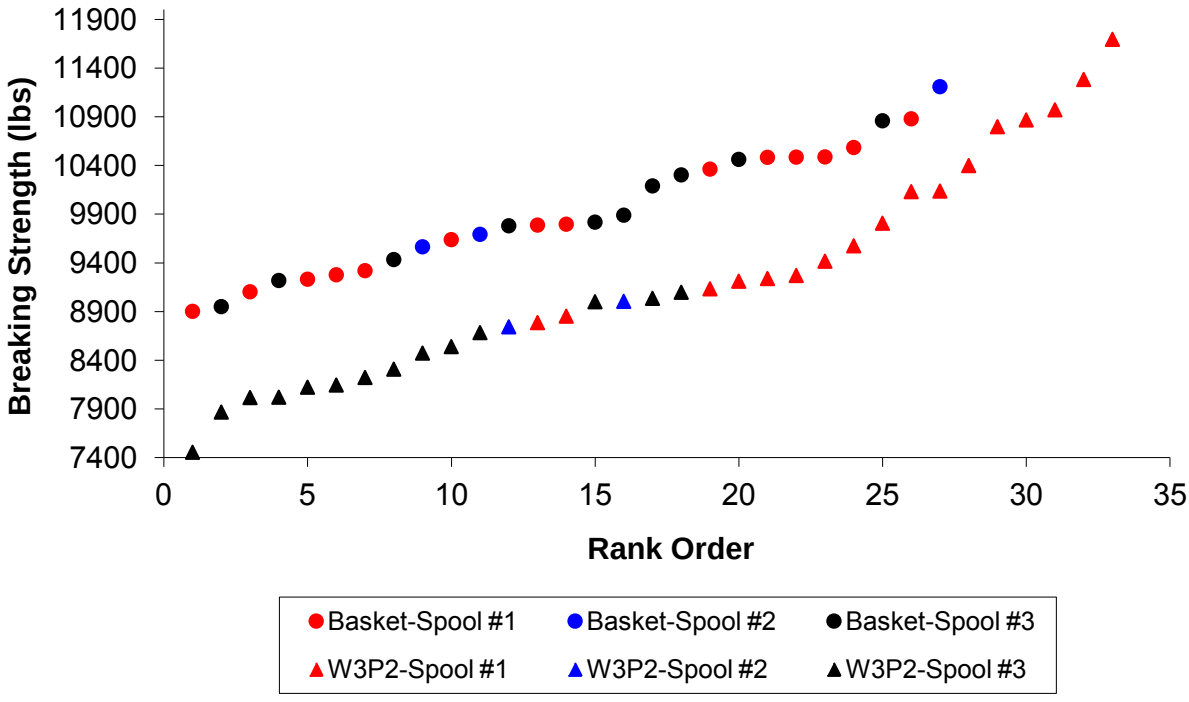

Table 1: Raw data and observations

Sample Number	Breaking Strength (lbs)	Scaled Breaking Strength (lbs)	Number of Breaks	Breakage Type	Notes/Abnormalities
1-B-1-1	10786	10879	2	Clean	
1-B-3-2	9153	9232	1	Clean	
1-B-5-3	10191	10279	2	Clean	Breaking strength taken from data file not machine
1-B-7-4	10494	10585	2	Clean	
1-B-9-5	9025	9103	1	Clean	
1-B-11-6	10394	10484	1	1/2 inch fray	
1-B-13-7	10396	10486	2	Clean	
1-B-15-8	11148	11244	2	2 inch fray, 4.5 inch fray	Loaded to 9150 lbs before slowing the pull
1-B-17-9	10274	10363	2	Clean, 1 inch fray	Main anchor strand failed
1-B-19-10	9984	10070	2	Clean	Was previously pulled, pulled to failure second time, New Anchor
1-B-21-11	10398	10488	2	Clean, 1 inch fray	
1-B-23-12	9781	9865	2	Clean	Was previously pulled, pulled to failure second time, New Screw Link
1-B-25-13	8826	8902	1	Clean	
1-B-27-14	9704	9788	1	Clean	Other side was half cut with a 2.5 inch fray, but did not fail
1-B-29-15	9240	9320	2	Clean	
1-B-31-16	9713	9797	2	Clean	
1-B-33-17	9556	9638	2	Clean, 2 inch fray	
1-B-35-18	9198	9277	2	Clean	
2-B-2-19	11113	11209	2	Clean, 1 inch fray	
2-B-4-20	9483	9565	2	Clean	
2-B-6-21	9610	9693	2	Clean	
3-B-2-22	9551	9633	1	Clean	Was previously pulled, pulled to failure second time, New Anchor
3-B-4-23	9353	9434	1	Clean	Other side was half cut but did not fail
3-B-6-24	9697	9781	2	Clean	
3-B-8-25	8874	8951	1	8 inch fray	
3-B-10-26	10103	10190	2	Clean	
3-B-12-27	10238	10326	2	Clean	Was previously pulled, pulled to failure second time, New Anchor
3-B-14-28	9734	9818	2	Clean, 2 inch fray	
3-B-16-29	10373	10463	2	Clean	
3-B-18-30	10766	10859	2	Clean	
3-B-20-31	9805	9890	2	Clean	
3-B-22-32	8860	8936	1	Clean	Breaking strength taken from data file not machine
3-B-23-33	10215	10303	2	Clean	
3-B-26-34	9140	9219	1	1 inch fray	

Table 1: Contintued

1-W-2-35	10077	10137	2	Clean, partial 2 inch fray	
1-W-4-36	8734	8786	1	Clean	
1-W-6-37	10071	10131	1	1/2 inch fray	
1-W-8-38	10803	10868	2	Clean	
1-W-10-39	9361	9417	1	Clean	One anchor strand broke but the anchor held and was pulled farther
1-W-12-40	9215	9270	1	Clean	
1-W-14-41	10906	10971	2	3 inch fray, 1.5 inch fray	
1-W-16-42	11626	11696	2	2 inch fray, 4 inch fray	
1-W-18-43	9518	9575	1	Clean	
1-W-20-44	10734	10798	2	Clean	Webbing fused together on the side of the pipe
1-W-22-45	9157	9212	1	Clean	
1-W-24-46	11216	11283	2	Clean	
1-W-26-47	9749	9807	2	Clean	
1-W-28-48	8800	8853	1	Clean	
1-W-30-49	9079	9133	1	Clean	
1-W-32-50	10337	10399	2	Clean, 3 inch fray	
1-W-34-51	9184	9239	1	Clean	
2-W-1-52	8951	9005	1	Clean	
2-W-3-53	8691	8743	1	Clean	
2-W-5-54	7401	7445	1	7 inch fray	Never moved to a slower pull, New Anchor and New Screwlink
3-W-1-55	8259	8308	1	Clean	
3-W-3-56	9044	9098	1	Clean	Unbroken strand had 2 inch fray at quicklink location
3-W-5-57	7411	7455	1	Clean	One anchor strand broke but the anchor held and was pulled farther
3-W-7-58	8097	8145	1	Clean	One anchor strand broke but the anchor held and was pulled farther
3-W-9-59	8423	8473	1	Clean	
3-W-11-60	8947	9000	1	Clean	
3-W-13-61	8489	8540	1	Clean	One strand broke but the anchor held and was pulled to >4000 lbs
3-W-15-62	8075	8123	1	Clean	
3-W-17-63	7821	7868	1	Clean	
3-W-19-64	7973	8021	1	Clean	Start of a fray near break
3-W-21-65	7969	8017	1	Clean	
3-W-24-66	8982	9036	1	1.5 inch fray	
3-W-25-67	9043	9097	1	Clean	Was previously pulled, pulled to failure second time, New Anchor
3-W-27-68	8174	8223	1	2 inch fray	
3-W-28-69	8632	8684	1	Clean	

=A measurement in which some abnormality was observed

Are Your Cow's Tails Safe?

(Reproduced from text of article published in Speleology, Issue 12, April 2008)

It has been said that the most abused part of caver's gear is the cow's tail. They get dragged around, trodden on, loaded over rough limestone, shock loaded and with all this, cavers still ignore the basic facts with some only discarding them when the sheath is worn and they can see the inner core.

Whilst one does not want this to happen because they are worn, there always seems to be a number of cavers who admit during discussions each year around BCA's rope test rig at Hidden Earth, "Oh well, mine is many years old and it seems OK". A quick glance at the British Cave Rescue Council's annual statistics since 1995 (BCRC) indicate that no one has had to be rescued following an injury caused by a failure of their cow's tails. (We excluded events caused by the lack of use of a cow's tail and those stated as taking place during abseiling. One incident was reported in which the injured person was found attached by their cow's tail at the head of the pitch, see BCRC incident 24 in 1998.) But how many people have suffered lesser injuries and got out under their own steam? This article is prompted by the recent publication of a report on some work undertaken in part on behalf of the French Federation of Speleology into the performance of cow's tails (2006).

Shock Loading & Impact Force

The focus of concern around a cow's tail is the potential for the caver to receive an injury following a fall onto their cow's tail. As the adage has it, "it is not the fall which kills you, it is the sudden deceleration at the end". Crawford (2003) reviewed the literature relating to the nature of injuries resulting from shock loading, which arose mostly from studies on use of aircraft ejector seat and parachutes. Of note in the review was the fact that the harness can deliver a shock loading into the body which does not break any bones or cause spine damage, but can result in severe impact trauma to internal organs (brain, heart, liver, spleen, etc.) resulting in death (Crawford 2003). Although the topic is complex (depending not just on the deceleration force, but also upon the rate of change of the deceleration force as well as the type of harness and the weight of the person), work has led CEN (European Committee for Standardisation) to adopt a limit of 6kN so as to minimise the risk of injury from sudden deceleration (Crawford 2003). In the USA a value of 8kN has been adopted (Crawford 2003). The review found evidence which suggested that physically fit persons could withstand up to 12kN in parachute type harnesses without being injured (Crawford 2003).

A typical SRT setup when using a cow's tail, will include in order of connection, some rock, an anchor (usually steel), a crab, the cow's tail, a maillon, and a harness within which the body sits. Clearly the rock and steel components will hardly absorb any energy of the shock loading from a falling mass. Harnesses are made from tape and tape is a poor shock absorber when compared to rope (FFS 2006). Curiously, the European standard for dynamic rope (BSI 1997) only requires that the impact force from dropping an 80kg mass through approximately 4.8m on a 2.8m length of single rope shall not exceed 12kN. In contrast the European standard for semi-static (i.e. low stretch kernmantle) rope (BSI 1998) only requires that the impact force from dropping a 100kg mass through approximately 0.3m on a 2m length of single rope shall not exceed 6kN. Whilst it is not possible to compute an equivalent impact force for a standard weight and drop, it is clear from the figures that

a semi-static rope is far less absorbent of a shock than a dynamic rope. This is borne out by tests undertaken by French Federation of Speleology (2006) which shows higher peak force loads due to semi-static ropes than dynamic ropes.

Drop Testing

Lyon Equipment Ltd carried out a large amount of work for the UK's Health and Safety Executive into items of personal protective equipment used in industrial roped access (Lyon 2001). Part of this work focused on cow's tails, or as they are known in the rope access business, attachment lanyards. Their work, which used a 100kg mass falling through fall factor 2, was constrained by the limit of the measuring equipment being only 10kN force. Some of the tests did result in readings going off the scale. Even so, it was clear that using loops in dynamic rope made by sewing resulted in a larger peak force than using loops made by knots in a semi-static rope which in turn resulted in a larger peak force than using loops made by knots in a dynamic rope (Lyon 2001). The report noted that "With all the knots tested, extreme tightening occurs during the impact: this would be obvious on inspection and in the workplace the cow's tail should be replaced immediately" (Lyon 2001).

The work undertaken by the French Federation of Speleology (2006) expands this knowledge base by a substantial amount. Some 294 dynamic fall tests were conducted together with 28 strength tests on a range of cow's tails including both manufactured (loops made by stitching rope or tape) and knotted (dynamic and semi-static rope of various diameters). The dynamic tests used an 80kg mass to represent the caver, which is probably an underestimate of a caver's weight. Recent work undertaken for the Health and Safety Executive (LUABS 2005) indicates that it is likely (95% confidence) that the interval 112.3kg to 118.4kg covers the true value of the 95th percentile for the weight of workers without equipment. The French pre-tensioned their knots to 3kN whereas Lyon Equipment used 2kN. (For comparison, a strong person may be able to pre tension a knot to about 0.5kN by simply pulling on it.[1]) The value of 3kN was based on previous work done by the French Federation of Speleology (2006). Interestingly, Lyon Equipment measured forces generated by a person abseiling and prusiking (2001) which were all less than 1.6kN.

Calculating the Fall Factor

The report notes that there are a number of factors which need to be taken into account in computing the fall factor of a cow's tail in use. They point out that the length of the crab plus the maillon (typically 0.18m) is significant in comparison to the length of a cow's tail (typically 0.36m and 0.60m). Most of their fall factors were quoted as being either 1 or 2 but the report details what this means. Clearly, when one has an overall fall distance of 0.63m for a 0.36m length of rope (which includes the two knots), the rest being made up of two karabiner lengths (one switching from being below to being above the connection point on the harness), then the fraction of the overall length which is able to absorb energy is nowhere near 100% as is conventionally assumed. (Slightly confusingly, several tests were undertaken using the distance of the setup measured under the 80kg load called 'real fall factors'. This at least reflects the approach used in the standards to measure rope lengths when undertaking drop tests.)

It is worth noting that a simple model of a length of rope whose ends have been made into loops formed by knots suggests that over 20% of the energy is taken by the knots for a 0.30m-long cow's

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[1] Based on 100lb force in a modern bow, see http://en.wikipedia.org/wiki/English_longbow as at 16 October 2012.

tail, reducing to less than 5% for a 2m-long cow's tail (Mehew 2005). This influence of the knots was observed in the peak forces experienced by samples of the same rope but having differing lengths (FFS 2006) and also differing diameters. Thus the state of the knots can play a critical role in shock absorbing.

Repeated Falls

The report includes a number of repeated falls on cow's tails which showed an increase in peak force on the second and third fall (FFS 2006). Hence knots which have been tightened up either by prior use or from a fall, will absorb less energy in a subsequent fall, thus resulting in a higher peak force and hence increasing the possibility of injury.

There was only one partial failure on a third fall factor 1 drop (Test 238, see photo on page 6 of report) but this was using 8mm rope. In a number of fall factor 2 drops, the cow's tails failed on the second fall (FFS 2006) but these were in 9mm or smaller diameter rope. This just reaffirms the sense of using at least 10mm dynamic rope for one's cow's tails!

Choosing the Right Knots for Increased Safety

Figure 1

The report covers a wide range of single lanyards and cow's tails including one made from tape, several made from sewn dynamic rope and many made from various combinations of knots and rope types.

The work showed a variation with respect to combinations of knots at each end, see table opposite. For comparison the Lyon Equipment work indicated somewhat larger peak force values.

It should be borne in mind that whilst the French pre-loaded the knots to 3kN, Lyon only used 2kN and that whilst the French used an 80kg mass, Lyon used 100kg. However, the spread of the data for both the French and Lyon work which makes up these averages does not statistically justify a claim that any one combination is better than any other combination (Mehew 2008). Interestingly, tests done with badly positioned barrel knots (FFS 2006) which might interfere with the gate of the crab, see Figure 1, showed the knot would move back to the proper position under the shock load.

Figure 2

Traditional cow's tails comprise of a central knot, normally an overhand loop knot with either a figure of eight knot or a barrel knot to hold the karabiner at each end, see Figure 2.

As the rope used in the construction of most cow's tails is dynamic rope, it makes sense that a knot capable of absorbing energy is also used. The barrel knot is not only a good knot for energy absorption, but it will also hold the karabiner captive

once dressed (semi-tensioned). The use of a single knot to the central maillon does give rise to a slight reduction in ultimate safety as a single knot is being used for attaching two cow's tails to a central strong point. For the ultimate in safety each safety link should have it own attachment knot.

Figure 3

By constructing one's cow's tails slightly differently, features can be added that enable them to be used more efficiently and increase their safety margin. In Figure 3 there are two overhand loop knots attaching the cow's tails to the central maillon. This increases the safety margin as each cow's tail is independently attached to the harness. These two knots leave a small loop (which can be lengthened during construction if necessary) between them. This now effectively gives the user a long cow's tail, a short cow's tail and a very short cow's tail. This very short cow's tail has numerous advantages. It can be used to attach to anchors where the user wants to be held in close proximity which certainly makes passing re-belays easier. In the event of rescue it gives a very short attachment point so the casualty is kept close to the rescuer. If teaching SRT it gives an additional attachment point while positioning the long or short cow's tails.

Caring for Cow's Tails

So how should you look after your cow's tails? First if you do fall onto your cow's tails, then at the next practicable opportunity (that is when you have got to a safe location away from the pitch) you should relax the knots and re-dress them. This action will reduce the tension within the knots and thus enable them to absorb more of the force which would arise if you fell again onto them, thus reducing the risk of injury to you. After each trip untie all the knots, rinse the rope thoroughly in clean water and hang in a dry, well ventilated place to dry (not in the sun). Before retying the knots inspect the rope for any signs of damage or wear. Once the knots have been retied, dress them to ensure correct tying and uniformity. If they show any signs of damage, replace them. The choice is yours, extend the life of your cow's tails or your own life!

Bob Mehew
Les Sykes
Damian Weare

Note added in 2012

Subsequent research work suggests that overhand knots are likely to be statistically weaker than figure of eight or barrel knots.

Bob Mehew
rope@british-caving.org.uk

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Minutes of the
NSS Vertical Section Executive Committee E-Meetings
July 2011 to April 2012

The NSS Vertical Section Executice Committee held a series of E-meetings on a variety of issues during the period from July 2011 to April 30, 2012. Executive Board members participated in the meeings via email, telephone and regular mail.

August 22, 2011 to September 1, 2011 - Establishment of Outreach Committee

An e-meeting was called by Chairman Dick Mitchell for the purpose of establishing a special committee to be named the Outreach Committee. Vice Chairman Terry Mitchell was designated to be the meeting chair for conduct of this meeting.

The following motion was made by Dick Mitchell and seconded by Ray Sira:

"I move that the NSS Vertical Section create a special committee named the Outreach Committee. The purpose of the Outreach Committee will be to develop a plan of action that includes but is not limited to the following goals:

1) Increase awareness across the Vertical Community, both within and outside of NSS, of the existence of the Vertical Section and what the Section can provide;
2) Increase the membership of the Vertical Section in numbers, and broaden its age distribution to better reflect the current caving population;
3) Define methods to obtain more involvement and communication of members within the Vertical Section.

The Chairman of the Vertical Section will appoint the chairman of the Outreach Committee. The committee chair will then recruit and appoint additional members of the committee, attempting to comprise its membership with a representative cross-section of the Vertical Section. The committee will formulate a recommended plan of action to be submitted by Feb 1, 2012, to the Executive Committee for approval and implementation."

Following a period of discussion, a vote was held with 8 in favor and 1 not responding. The motion passed and the Outreach Committee was established with Terry Mitchell appointed as Chairman.

NOTE: Due to personal issues, Terry Mitchell later had to resign from the position of committee chairman. In April 2012 Marty Reames was appointed as Outreach Committee Chairman.

NOTE: There were other discussions on various topics between Executive Committee members throughout this period. None of these are recorded in these minutes since no motions were made or voted on and they did not constitute E-meetings.

Respectfully submitted,
Bill Boehle

(Rev.0)
Approved by EC e-meeting 05/20/2012

Minutes of the
NSS Vertical Section Executive Committee E-Meetings
May 2012 to June 2012

The NSS Vertical Section Executive Committee held a series of E-meetings on a variety of issues during the period from May 2012 to June 12, 2012. Executive Board members participated in the meeings via email, telephone and regular mail.

August 22, 2011 to September 1, 2011 - Establishment of Outreach Committee

Minutes previously approved 5/20/2012 (see below). Following is an amended NOTE:

NOTE: Due to personal issues, Terry Mitchell later (10/20/2011)had to resign from the position of committee chairman. In April 2012 Marty Reames was appointed as Outreach Committee Chairman. As of May 9, 2012, Marty recruited four other members to serve on the committee.

May 4, 2012 to May 23, 2012 - NSSVS Awards

The VS Board has been making efforts to formally recognize those who have made significant contributions to and otherwise served the Vertical Section over the years. In addition, the VS Board recently established criteria to guide the Awards Committee in considering nominations for the Vertical Section Lifetime Achievement Award. This award is intended for individuals who have provided a contribution to vertical caving, recognized nationally, that has benefitted the activity in terms of technique, equipment, or knowledge base.

The Awards Committee received a nomination recommending that an award be given to Bill Cuddington: Pioneer of the Single Rope Technique that revolutionized vertical caving in the United States. On May 17, 2012, an e-meeting was called to consider theis nomination. After review and discussion, as of May 23, 2012 there was a unanimous vote in favor of the award. The VS Board conducted this action without the knowledge of EC members Bill and Miraim Cuddington in order to maintain the surprise of the award.

May 11-20, 2012 - Approval of minutes from VSEC regular and E-meetings

The minutes from 2010-2011 E-meetings, from the Sunday July 17, 2011 VSEC meeting, and from 2011-2012 E-meetings through April 30, 2012 were approved (with one typographical correction) by unanimous consent of the VSEC as of the close of the E-meeting on May 20, 2012.

May 11-23, 2012 - Approval of amendment to Outreach Committee's Plan of Action submisssion date

When the EC established the Outreach Committee on September 1, 2011 (see previous minutes), a date of Feruary 1, 2012 was set for the submission of a recommended plan of action. With the delays in getting this committee off the ground that date had passed. The pupose of this action is to provide an amended target date for the committee to report to the EC. A motion was made (Bill

Boehle) and seconded (Ray Sira)that the date previously established for the NSS Vertical Section Outreach Committee to develop a recommended plan of action and submit it to the Executive Committee for approval and implementation be changed from February 1, 2012 to June 30, 2012. The motion was approved by unanimous vote of the VSEC as of the close of the E-meeting on May 23, 2012.

May 31 - June 3, 2012 - Approval of the updated Basic Vertical Course previously provided to the VSEC on May 17, 2012

As discussed in Glenwood Springs in 2011, Bruce Smith committed to update specific portions of the Basic Vertical Training Course. After receiving substantial feedback from many sources across the country, he has updated and made current the Basic Vertical Course which was last done in 2008. A motion was made (Bruce Smith) and seconded (Bill Boehle) to accept the updated version of the Basic Vertical Course.

Dick Mitchell moved (Bill Boehle seconded) that we Suspend the Rule of Bylaw 9 (B) (vii) d. which requires us to conduct a minimum 5-day discussion period before voting on an e-meeting motion, and that the vote on the main motion by Bruce Smith be conducted without discussion. Since this update was previously circulated to the EC for two weeks, it was desired to expedite this particular e-meeting process and approval, within our Rules of Order, so that Bruce will have enough time to finalize and publish some paper copies of the updated manual for distribution at the NSS Convention. The motion was approved by majority vote of the VSEC as of the close of the E-meeting on June 3, 2012.

June 12, 2012 - Appointment of Bruce Smith as Awards Committee Chairman

Due to his recent election to the NSS Board of Governors, and his commitments thereto, Dick Mitchell stepped down as Chairman of the Awards Committee. He has appointed Awards Committee member Bruce Smith as the new Chairman, consistent with the Vertical Section By-Laws Section 5), (F).

NOTE: There were other discussions on various topics between Executive Committee members throughout this period. None of these are recorded in these minutes since no motions were made or voted on and they did not constitute E-meetings.

Respectfully submitted,
Bill Boehle

(Rev.1)
Approved by EC e-meeting 1/28/2013

Minutes of the
NSS Vertical Section Executive Committee Meeting
June 24, 2012

The NSS Vertical Section Executive Committee held a meeting on Sunday, June 24, 2012 at the Hampton Inn near the 2012 NSS Convention in Lewisburg, West Virginia. Executive Board members present were Secretary-Treasurer Bill Boehle, At-Large Executive Members Terry Mitchell and Ray Sira, Vertical Techniques Workshop Coordinator Terry Clark, and Education/Training Coordinator Bruce Smith. Nylon Highway Editor Tim White could not attend the convention. Contest Coordinator Bill Cuddington could not attend the meeting and Bruce Smith was designated as proxy. At-Large member Miriam Cuddington could not attend this meeting and Terry Mitchell was designated as proxy. Vertical Section member (and rebelay course coordinator) Gary Bush was also in attendance. Chair Dick Mitchell arrived late from the airport and did not attend the meeting.

Meeting opened at 7:30 PM by Vice Chair Terry Mitchell.

The purpose of the meeting was to discuss and deal with various issues that needed to be addressed before the annual business meeting on Wednesday.

1. Terry Mitchell reported that the Vertical Section business meeting will be held on Wednesday, June 27, 2012 in Room G-111 at 2:00 PM.

2. Bill Boehle handed out copies of the Secretary's Report and Treasurer's Report and pointed out that our membership numbers are flat not increasing. Relative to Symbolic Items, it was pointed out that we will have to place an order before next year since we are out of stock for a number of items.

3. Nylon Highway Editor Tim White is not at the convention and there is no report submitted.

4. Vertical Contest/Rebelay/Workshop rigging and facilites. Terry Clark reported that we have the rope from PMI and that the gym facilities are okay. Rigging will begin Monday morning at 9:00 AM. No manlift was provided and we will need to set up scaffolding in order to rig. Terry also stated that he needs to get the registration numbers from the convention staff for those already signed up for the Vertical Workshop.

5. Education/Training Coordinator Bruce Smith reported that the update to the Basic Vertical Training Course was completed and that the changes were accepted by the EC just prior to convention. He has had copies of the course printed and distributed copies the EC. To get this material out to the membership and other vertical users, it was agreed to distribute copies to those attending the business meeting, the workshop, and any grotto training officers who ask for a copy during convention. A notice to this effect will be published in the convention daily rag sheet.

6. Awards Committee Chair Bruce Smith reported that the Lifetime Achievement Award for Bill Cuddington will be presented at the business meeting on Wednesday. He will be putting a notice in the convention daily rag sheet to get some publicity for this event.

7. The Bylaws Committee had nothing to report for this year.

8. Webmaster Gary Bush reported that the the website is up to date except for some pictures that need to be posted. He also asked if we want to upate the "look and feel" of the site. Some discusssion followed.

9. Outreach Committee Chairman Marty Reames was unable to attend convention this year, but has been in contact via email and sent a report (see Attachment). The report presents the background and status of the committee and proposes a list of action items the committee would like to pursue. The committee also recommended that they be considered a permanent subcommittee of the Vertical Section due to the long term nature of membership recruitment and retention. After some discusssion, it was concluded that no specific action on this is required since the committee will continue in force until and unless the EC dissolves the committee previously formed.

The EC went over the committee report and discussed the courses of action proposed. It was agreed that the committee had made great progress in a short time and had come up with some new and progressive ideas.

Motion to Approve NSS Vertical Section Outreach Committee Plan of Action made by Ray Sira and seconded by Bruce Smith.

"Moved that the Plan of Action submitted by the Vertical Section Outreach Committee, consisting of five courses of action, to wit:

1. Enhance Online Communication.
2. Reach out to the Grottos.
3. Educate New Vertical Section Members.
4. Coordinate Fun Events.
5. Submit Articles to the NSS News.

be approved, and further, that the Outreach Committee is authorized and directed to take steps that implemant these approved courses of action.

Any implementing steps that could be considered extremely controversial or that require an expenditure of funds over $100 must first be submitted to the EC for approval.

The Outreach Committee is further directed to make an initial report in six months as to the status of the imlementation of the approved plan of actions, and to submit a budget for approval, if needed, for expenditures exceeding $100."

The motion was passed 5-2 with Bill and Miriam Cuddington's proxies voted no.

10. Under New Business it was noted that for the upcoming elections that Dick Mitchell was probably not going to run for at-large reelection due to his new commitments to the NSS BOG.

11. Terry Clark observed that we are going to have a very busy week. He wondered if there could somehow be better scheduling.

Adjournment - Motion to adjourn was made and carried. Time of adjournment was approximately 9:13 PM.

Respectfully submitted,
Bill Boehle

(Rev.1)
Approved by EC e-meeting 1/28/2013

Attachment to June 24, 2012 VSEC Meeting Minutes

NSS Vertical Section - Outreach Committee
June 2012 Report

In April 2012, an Outreach Committee for the Vertical Section of the NSS was formed. The initial members of this committee are Marty Reames, Ray Sira, Dave Schmidt, Jon Schow, and Paul Ryan. Additional members of our team are welcomed. If you would like to join the committee and/or would like to help us with the ideas presented here, please contact Marty.

Our understanding of the committee's goal is to promote membership focusing on the younger population of cavers who will eventually become the Vertical Section's leadership.

In the short time we have been together, we have come up with the following:

1 - Enhance On-line Communication - The Internet, especially social media, has become the primary channel younger generations use to communicate. We recommend making it easier for our existing website to be found and creating a presence on social sites, such as facebook, google+, and twitter.

2 - Reach Out to Grottos - Vertical skills are primarily taught through grotto practices. Find and distribute materials to aid them in grotto vertical practice sessions.

3 - Educate New Members - Create a welcome packet that can be given to new members of the Vertical Section. This should include an overview about the Vertical Section, information to aid new members in improving their vertical skills, and ideas on how they can get involved and be active in the section.

4 - Coordinate Fun Events - In addition to the existing vertical competitions and workshops, add in fun demonstrations and competitions. For example, have two climbers dress up in different costumes, such as batman and superman, and see who wins. This will also give us some pictures and content for the facebook page.

5 - NSS News - Write articles periodically for the NSS News to generate interest.

These are our initial thoughts, and it will take some time to fully implement. In addition to the above efforts, I recommend that this committee be considered a permanent sub-committee of the Vertical Section, as recruiting new membership is key to keeping any organization alive.

We request permission from the Executive Committee to proceed forward with implementing these ideas.

Thanks,
Marty
NSS Vertical Section Outreach Committee Chair

Minutes of the
2012 NSS Vertical Section Meeting
June 27, 2012

The 2012 NSS Vertical Section meeting was held Wednesday, June 27, 2012 at the High School in Lewisburg, West Virginia. Executive Board members present were Chair Dick Mitchell, Secretary-Treasurer Bill Boehle, At-Large Executive Members Miriam Cuddington, Terry Mitchell (Vice Chairman), and Ray Sira, Vertical Techniques Workshop Coordinator Terry Clark, Education/Training Coordinator Bruce Smith, and Contest Coordinator Bill Cuddington. Nylon Highway Editor Tim White could not attend the convention. Approximately 24 additional Vertical Section members were in attendance.

I. Meeting opened at 2:06 PM by Chair Dick Mitchell.

A. Announcements - Welcome to everyone who came. Agenda, minutes, and other information available in packet. Membership/Attendance roster circulated. Introduced EC members present.

II. Minutes of the Last Meeting - Minutes of the 2011 VS business meeting were published on the website and there were no amendments or changes. A motion was made and seconded and the minutes were accepted as published.

III. Officer's Reports:

A. Secretary's Report - Bill Boehle. See attached. Our membership numbers have been very slowly growing, but we would hope to do better. Efforts to grow the membership will be addressed by the new Outreach Committee later in the meeting. Accepted as presented.

B. Treasurer's Report - Bill Boehle. See attached. No further discussion. Accepted as presented.

C. VS Symbolic Items - Bill Boehle. See Treasurer's Report for sales numbers. We will be doing a restocking of clothing items before next year. We will also need to have more of the section pins made since we are totally out of stock. Both of these will be a major expense that will show on next years report.

D. Nylon Highway Editor's Report - Tim White could not attend convention and no report was submitted. Gary Bush reported that he had been in email contact with Tim and that Tim had submitted to him the cover art and an article for Nylon Highway #57 which has been posted on the website. Tim is in need of more articles for the Nylon Highway.

The regular meeting was paused for a side issue:

The meeting was interrupted by Geary Schindel who is the Administrative Vice President (AVP) of the NSS. He stated that he wants the help of the Section to address a couple of issues that he is concerned about. He was passing by the gym and saw some kids vertical training in there without wearing helmets. His concern with the safety issues is that if anyone got hurt that it might be the end of vertical section training. It was pointed out to Geary that the training he saw was a JSS activity, not a Vertical Section activity. While some of our members assist the JSS with this, it is not our activity. Not everyone participating brought a helmet and there were not enough to go around. Existing

helmets were used by anyone rappelling but not by all ascending. Geary acknowledged this, but still had a concern since we are all under the general liability umbrella of the NSS. What Geary would like to see is some training safety standards written by the Vertical Section for the JSS, possibly involving a safety officer and a safety plan. This could address issues such as requiring a helmet to be worn by all participants. Geary acknowledged the safety record of the Vertical Section during workshops and the climbing contest, but points out that we would only get one shot at this. If there was an accident involving the kids, the NSS would probably not be able to get any insurance in the future for NSS activities. Geary (acting for the NSS) would like for the Vertical Section to come up with a safety plan for JSS vertical activities, hopefully before next convention. This would set criteria and safety standards for participation in these activities and would assist and guide the JSS chairperson (who may not be vertically experienced). More discussion ensued and Chairman Dick Mitchell (with the concurrence of the EC) concluded that this is something that needs to be carefully considered by the EC to determine an appropriate course of action. Dick committed to stay in contact with Geary as we proceed.

Geary left at this point and some additional discussion followed. Gene Harrison suggested that both students and intructors should use appropriate safety gear at all times. We need to build a culture, image, and tradition of safety so that a student can't get hurt and later claim that "I was trained that way"! Terry Mitchell asked for some volunteers from the membership to work with the EC and take the lead in compiling existing information and guidance into a safety plan for JSS vertical activites. Jim Wade and Ken Alwin volunteered.

End of side issue and back to the regular meeting.

IV. Committee Reports:

A. Contest Committee - Bill Cuddington. Thanks to the convention for the nice facilities for this years contest. The room was cool and restrooms were nearby. Thanks to all who help during the vertical contest, especially Ernie Coffman and the other racketteers who helped run the racks. We appreciate any help from section members and others with timing, pulling rope, running the rack, etc. An hour here and there really helps spread the work out. Regarding the use of helmets during the climbing contest, it was noted that they have been optional. People tend to overheat during long climbs and don't have the opportunity to rest to cool off during the timed climb as they would in a cave situation. Since we are climbing in a controled environment, with mats and the ability to lower a climber down, we consider allowing optional helmet use to be an acceptable risk.

B. Vertical Workshop - Terry Clark. This year we have 22 to 25 people signed up. Terry pointed out that we require helmets for participants in the vertical workshop. He also noted that he sometimes uses his discretion and relaxes this rule for some intructors who might fly in to a convention and are unable to bring their helmet with them. It also depends upon the job assigned to an intructor. Some jobs (such as knot tying, harness and equipment checks, or running a rack) do not expose the intructor to falls or overhead risk. After some discussion of what should be required, Dick Mitchell stated that the Section might want to consider purchasing a few helmets to be available for any intructors who might be unable to bring their equipment to convention. Terry noted we are continuing to cut up the contest ropes for use in the workshop. This way we are getting more use out of the donated ropes and have less gear to haul to the convention. It was also suggested that we need to add long pants to the list of items particpants need to bring to the workshop. In recent years

some people have been getting scraped up and bruised by the ropes and equipment due to wearing shorts during the training.

C. Training/Education - Bruce Smith.

Bruce stated that he has finished the series of updates to the Basic Training Course (the first since 2008). There are updates to the information on harness hang syndrome, on rappelling errors made when changing the number of bars used during a descent, and the adding of a section on blowout training scenarios. In testing this revised course, the blowout scenario training has proved very enlightening to students. It reinforces their training in dealing with unexpected problems while on rope. Bruce stated that we need to encourage local grottoes to use the full course to provide comprehensive vertical training to its members. While some "regionalization" of training occurs, grottoes should not short change the training. To roll out this updated training, and as a way to give back to the NSS, we have printed a limited supply of the new manuals to be distributed during the convention to those present in this meeting, to workshop participants on Thursday, and to grotto chairmen or training officers upon request. The updated manual will continue to be distributed in PDF form via the website.

It has been three years since we completed the Intermediate Course and made it available via download for no charge on the website. We have 10 students registered (from 2009) that they have started the course. All are still working on the course at their own pace. This is not an overwelming response to the training course, but we applaud their perseverence in pursuing their quest for knowledge. The Intermediate Course is not about knowing just your own system, but knowing about many types of systems so you can assist other people.

D. Re-Belay Course / "Dial In Your Gear" Session - Gary Bush and John Woods. This year a steady stream of people showed up from 10:30 to 5:00 for the rebelay training. Gary reported that there were about 15-16 climbers and it was well received by all who participated. John spent most of the time with people setting up and adjusting their systems. This continues to be a very educational and productive session.

E. Awards Committee - Dick Mitchell/Bruce Smith. Due to his recent election to the NSS Board of Governors, and his commitments thereto, Dick Mitchell stepped down as Chairman of the Awards Committee. He has recently appointed Awards Committee member Bruce Smith as the new Chairman, consistent with the Vertical Section By-Laws Section 5), (F). Bruce took over the meeting to present a Lifetime Achievement Award to a most deserving individual. In a moving presentaion, Bruce noted that it was 60 years ago (1952) that a caver descended a pit in Monroe County not far from the convention site and then climbed out of that pit on hemp rope using prussiks. This was the first time this had ever been done and established the start of single rope techniques which have changed the way the world climbs rope. There is an iconic photo of a caver carrying a coil of rope and bent over near an old encrusted saltpeter vat. That photo memorialized this historic occasion. That caver was Bill Cuddington. Bill was presented with a plaque that recognized him as a pioneer, teacher, and innovator of single rope technique that revolutionized vertical caving. A loud standing ovation followed the presentation.

F. Bylaws Committee - Bill Boehle and Terry Mitchell. Terry Mitchell reported that there were no new changes this year. There are a few minor housekeeping items that we will probably address next year.

G. Web Page - Gary Bush webmaster. Gary reported that we are up-to-date, although the basic look of the website has not changed since the late 1990s. If anyone has any suggestions as to any content or links they would like to see on the site, they should contact him. Gary also reported that he has received many photos for the photo gallery on the website where we can display photos from past events. The most recent photos are from 2009. If anyone has photos of past meetings, contests, or other events, they should send them to Gary Bush to be included. Please identify dates, locations and people, if possible. Photos should be in 800x600 or 600x800 size format.

H. Outreach Committee - Marty Reames. Terry Mitchell presented the report for Marty who could not make it to convention this year. Terry reflected that at last years convention we discussed the need to increase our membership numbers, to address the aging of our membership by recruiting younger members, and to better involve those younger members to provide for future leadership of the organization. Following the convention, the Executive Committee (EC) established the Outreach Committee to pursue a series of goals to achieve our objectives. Marty was appointed Chairperson of the committee and empowered to recruit other members to serve on the committee. This was done and included Dave Schmidt, Jon Schow, Paul Ryan, and Ray Sira who is also member of the EC. The committee finally got started and a report was presented to the EC last week. This report outlined 5 courses of action that they would like to implement: 1. Enhance Online Communication; 2. Reach out to the Grottos; 3. Educate New Vertical Section Members; 4. Coordinate Fun Events; and 5. Submit Articles to the NSS News about vertical activity. The EC approved the Plan of Action and provided some further guidance. Further details can be found in the EC meeting minutes. Ray Sira provided some additional comments as an Outreach Committee member. Ray stated that it took some time to get the committee formed and for them to begin meeting. Most of the work was done in the last two months before convention. They made some good progress in a short period of time and will now move forward with implementation.

V. Old Business:

A. None.

VI. New Business:

A. The NSS has recently purchased a new building in the Huntsville area for it's expanded headquarters. Dave Hughes, who is the NSS Archivist for the HQ, spoke to the need for people to consider during their estate planning to get any historic vertical equipment to the NSS so that it can be preserved as part of the NSS Museum that will have expanded space as part of the NSS HQ complex.

B. The new NSS HQ in Huntsville is the focus of fundraising efforts to pay down the mortgage as soon as possible. There are many options available to contribute to this effort and Dick Mitchell (who is also on the BOG) briefly went over them. A plea was also made for the Vertical Section to consider making a donation to the new headquarters mortgage fund. A discussion followed on if the section would like to make a donation, and, if so, for how much. A motion was made (Ernie Coffman) and seconded (Ed Sira) to make a donation of $2000. More discussion followed. It was suggested that we should get some of the "buy a bricks" ($100 each) with the Vertical Section name inscribed on them that are one of the fundraising options. Gary Bush (also on the NSS BOG) explained some of the other donation options that are available. One of the options is to be a "benefactor" for an amount of $1000 or more, where your name would be inscribed

in the entry hall of the new building. Dick Mitchell pointed out that there will be accommodations made in the entryway atrium for rigging points for vertical activities. It was suggested that the Vertical Section could be a "benefactor" for these vertical facilities. Bill Cuddington commented that the Vertical Section should have some input on the design of any vertical facilities to ensure that they are adequate for their purpose. Both Dick and Gary (for the BOG) assured us that Section input would be part of the final design of any vertical rigging points. Bill Boehle (VS Treasurer) stated that he believed the $2000 donation suggested was too large a portion of our cash reserves. He felt that a $1000 donation was more resonable and still qualified as a "benefactor" donation. Gary Bush also explained that we could do the donation in a matching challenge format with our members. Discussion continued. Gary Storrick made a motion that was seconded by Bill Boehle to amend the original motion to change the donation to $1000. After discussion the motion to amend carried. A motion was also made, seconded, and carried to amend the motion to designate that the $1000 donation to the building fund would be a "benefactor" donation as discussed previously. The final amended motion was voted on and carried.

Gary Bush made a motion (seconded by Ed Sira) that the Vertical Section issue a matching challenge that it will donate up to $250 (dollar-for-dollar) for all donations made to the NSS Headquarters Fund by VS members by 7/31/2012. Donations so marked will be tallied by the NSS Office who will notify us at the end of the challenge period. The motion carried.

The hat was passed for the "buy a brick" program and $200 was raised to buy two bricks to be inscribed for the Vertical Section. NOTE: Money for this and for our "benefactor" donation was paid to the NSS Bookstore later in the day after the business meeeting.

VII. Elections:

A. Secretary/Treasurer (1 year term) - Bill Boehle was nominated and reelected by acclamation.

B. At-Large Board Members (2 year term, 2 to be elected) - Dick Mitchell, Terry Mitchell, and Mike Rusin were nominated. A ballot of the section members present was conducted. Terry Mitchell and Mike Rusin were elected by a majority of the votes cast. [Note: Current At-Large members Miriam Cuddington and Ray Sira have 1 year remaining in their terms.]

VIII. Adjournment - Motion to adjourn was made and carried. Time of adjournment was approximately 4:05 PM.

[Additional note: Subsequent to the Meeting, the Board Members elected Terry Mitchell as Chair and Ray Sira as Vice Chair. The four appointed members were re-appointed to serve for another year. They are:
* Contest Committee - Bill Cuddington
* Vertical Techniques Workshop Committee - Terry Clark (Assistant: Lynn Fielding)
* Education Committee - Bruce Smith
* Nylon Highway Editor - Tim White

Respectfully submitted,
Bill Boehle

(Rev. 1)
To be approved at 2013 Convention meeting

NSS VERTICAL SECTION

SECRETARY'S REPORT

June 2012

By Bill Boehle

Number of Members (current/just expired)	.....	269
Number of Members Current as of 2012	.....	268
Number of Subscribers Current as of 2012	.....	13
Number of Annual Volumes Paid for 2012	.....	0
Number of Complementary Subscriptions	.....	2

YEARS PAID:	MEMBER	SUBSCRIBER	ANNUAL VOLUME
Comps			2
2012	0	0	0
2013	112	3	0
2014	90	8	0
2015	53	2	0
2016	13	0	0
2011 Totals:	268	13	2
Expired 2011:	1	0	
Totals:	269		

NSS VERTICAL SECTION

TREASURER'S REPORT

June 2012

By Bill Boehle

INCOME:		
Nylon Highway Annual Volume Sales	.....	$0.00
Vertical Training Course Sales	.....	$35.00
2011 Convention Workshop Registrations	.....	$1025.00
Symbolic Item Sales	.....	$433.00
Nylon Highway Back Issue Sales	.....	$48.00
Shipping/Postage Charges	.....	$11.51
Donations	.....	$2.00
Bank Interest (Ally) June 2011 - May 2012	.....	$211.24
TOTAL INCOME:		$1,765.75
EXPENSES:		
Shipping/Postage Costs		$11.51
NSS - wesite hosting fees (2012)		$0.00
2011 Vertical Workshop Transportation Expense Subsidy (Terry Clark)		$xxx.00
2011 Climbing Contest prizes		$162.65
Vertical Workshop & Rebelay Course Supplies/Expenses		$258.41
Nylon Highway Annual Volume Production & Mailing Costs		$0.00
Symbolic Items Restocking (T-shirts, Sweats, etc.)		$0.00
Symbolic Items Restocking (VWS Instructor T-shirts)		$0.00
VS Recognition Awards		$0.00
Climbing Contest Record Boards (updates)		$0.00
Printing/Photocopying - Climbing Contest		$0.00
Photocopying/Supplies for 2011 NSS Convention administration		$35.48
Petty Cash for postage		$0.00
Training/Education Committee Printing Costs		$0.00
TOTAL EXPENSES:		$468.05
ACCOUNT BALANCES: (as of 5/31/2012)		
TD Bank (NJ)	.....	$3,602.59
Ally (formerly GMAC)	.....	$10,409.98
TOTAL:		$14,012.57