Equalization of Some Common Two Point Anchors Holding a Static Load

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Introduction

Nearly all rope systems start with an anchor, so understanding anchor construction and use is an essential skill for all riggers. In ideal conditions an anchor can be constructed using a single “bomb proof” anchor point (e.g. enormous tree or rock), however, frequently a strong enough single anchor point is not available, thus necessitating a multipoint anchor (a pre-tensioned backup anchor could also be employed as well). The kind of multipoint anchor to build can be difficult to decide because the properties of an anchor depend on the materials used, anchor configuration, and a host of other variables. Arguably, the most important property in multipoint anchor behavior is if the limbs are fixed length (load sharing, LS) or if they change length depending on the direction of loading (load distributing, LD). So understanding the dynamics of how LS and LD anchors work is an essential skill for those wishing to improve their rigging skills.

While there have been many multipoint anchor research projects in the past (see Evans 2016a for a review), some important results have not been replicated, and it is often difficult for users to find and access the research. As a result, the research here was designed to both replicate previous research to validate existing conclusions, and to produce a data set open to the public that can be re-analyzed if desired. I report here the results of anchor equalization trials using four 2-point anchor types (Sliding X, Equalette, Quad, and a two point Cordelette anchor) tied with 8mm nylon cord. The raw data is published along with this paper for re-analysis by any user.

Background

Probably the most fundamental difference between multipoint anchor types is whether or not they are load sharing (fixed length limbs) or load distributing (variable length limbs). Rigging lore suggests that the limbs in LS anchors do not hold equal proportions of the load because the limbs are fixed lengths and it is nearly impossible to tie an anchor with equally-loaded limbs. Under ideal conditions, unequal loading is not supposed to be a large problem; if an anchor point in a LS anchor fails, the load gently pendulums over to the other limbs because they are already both under tension. Unequal limb loading in LS anchors becomes a potential problem when the load shifts directions. The load can shift onto just one anchor point, thus producing the situation multipoint anchors are constructed to overcome, having all the load on one marginal anchor point. If this marginal anchor point should fail, then the load would dynamically fall on the other marginal anchor points, potentially creating a cascade failure of the anchor.

LD anchors are designed to overcome this problem with LS anchors, with limbs that change lengths when the load moves, so that each anchor point holds more or less equal proportions of the total load. The drawback to LD anchors is that if an anchor point fails, the slack created in the anchor causes a dynamic fall onto the remaining anchor points. Because there is slack in the system, the load free falls for a short while, which increases the total forces on the system when it is finally loaded. The net result is that the rigging community tends to think of LD anchors as preventing the failure of marginal anchors by distributing the load *during use* (e.g., more or less sharing the load evenly across anchor points), but during a failure of one of the anchor points, a LS anchor produces lower peak arrest forces when catching the fall.

It is important to check if traditionally held ideas are correct about how multipoint anchors function. An objective source of information is needed, not subject to the opinions of individuals. A great source of objective information is research data because it is not subject to the vagaries of personal opinion. While the discussion of results and conclusions drawn from data can be debated, the data itself is free from personal opinion. So what does research data suggest about how LS and LD anchors behave when loaded?

The data presented in Frank (2014) and McKently et al. (2007) both show that LD anchors do not effectively share a static load equally between anchor limbs. Similarly, Owen and Naguran's (2004) data show that LD anchors can share a static load less equally than LS anchors, which is contrary to perceptions in the rigging community. It appears the reason why the load is not shared equally is because of the friction in LD anchors prevents complete equalization. When LD anchors are constructed with pulleys at the anchor points, the equalization between limbs is nearly equal (Schafer 1991). These data suggest that LS anchors may more equally load anchor points than LD anchors when experiencing a static load (e.g., not a dynamic fall arrest). Because this conclusion runs contrary to the perceptions in the community of both anchor types, it is important to double check these results.

The data presented here were created to directly compare the behavior of three common two point LD anchors to the behavior of a two point LS anchor when experiencing a static load. These data are useful in determining which anchor type would be most useful in preventing an anchor failure when the anchor is constructed of multiple marginal anchors, and experiencing relatively slow loading (e.g., not a dynamic fall). Conditions of this nature are commonly found in rescue, caving, canyoneering, and some climbing applications, so the results are practically useful in some contexts, just not for understanding anchor behavior during dynamic loading.

Materials and Methods

BlueWater Ropes donated two spools of new unused 8mm nylon accessory cord (serial # 47364, lot # 813151, manufactured August, 2015) to SAR^3 as part of a much larger donation of ropes and cord for testing. The test results from the other equipment donated are reported elsewhere. The cordage was cut into four predetermined lengths, 1.52m (5.0ft), 1.98m (6.5ft), 2.44m (8.0ft), and 3.96m (13ft), corresponding to the length of cord needed to construct the four anchor types tested. Each length was cut such that the short and long cord lengths were distributed evenly throughout each spool. Table 1 details the cordage lengths used for each anchor, number of samples from each spool and total number of samples of each anchor type.

Table 1: Anchor type, cord length, and number of samples from each spool. Anchor name nomenclature taken from Long and Gaines (2013).

Anchor Type	Length				Samples from Spool #1	Samples from Spool #2	Total Number of Samples
	Feet	Inches	CM	Meters			
Sliding X	5.0	60	152	1.52	4	6	10
Equalette	6.5	78	198	1.98	3	6	9
Quad	13.0	156	396	3.96	3	6	9
Cordelette	8.0	96	244	2.44	3	6	9

The cord lengths were all tied into loops using a double fisherman's knot, then tied into one of four anchors using overhand knots (if appropriate): 1) Sliding X, 2) Equalette, 3) Quad, and 4) Cordelette. The anchor nomenclature used here is from Long and Gaines (2013), so the anchors of the same name here are directly comparable to their anchors of the same title. Figure 1 depicts all four anchors during testing to illustrate exactly what was constructed so there is no confusion. The Sliding X (i.e., Magic X) was constructed by clipping a large SMC locking steel carabiner into a cord loop with a twist in it, so the carabiner could not disconnect from the loop if one anchor point failed (Figure 1A). The Equalette was tied by doubling up the cord loop and tying two overhand knots about 15cm (6in) apart, and clipping in to both strands between the overhand knots like a Sliding X, again using a large SMC locking steel carabiner (Figure 1B). This connection method was used to minimize the potential systematic breakage of steel carabiners during testing (steel carabiners are expensive!), and it is acknowledged that another safe practice is to clip in to each strand separately with two different locking carabiners instead. The Quad was tied similarly, by quadrupling up a loop of cord, tying two overhand knots in line, and clipping in two different ways. Five samples were tested with a single steel locking carabiner clipped over three strands (see Long and Gaines [2013:148-149, 176] for examples of this method), and four samples were tested with two steel locking carabiners, each clipping over two strands each (Figure 1C). The Cordelette anchor was tied by tying an overhand on a bight in a loop of cord so that each limb was the appropriate length (Figure 1D). All anchors were tied by the author (T.E.) at the same time for consistency.

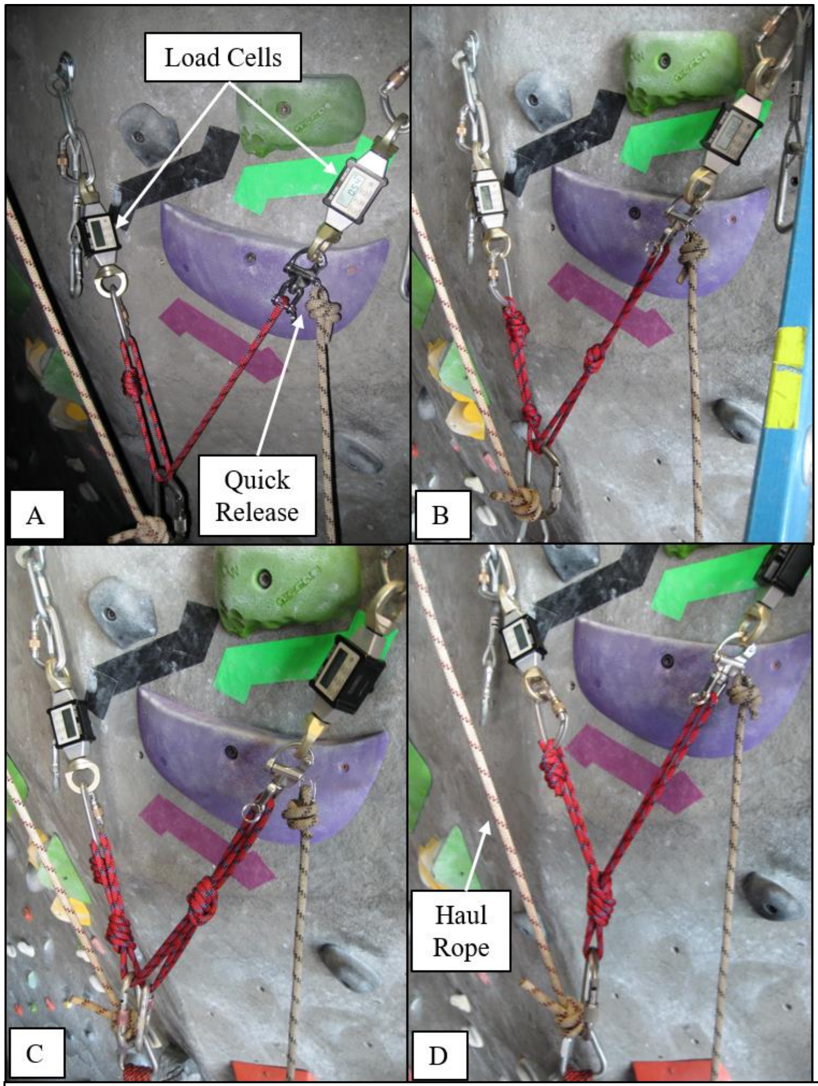

Figure 1: The equalization test configuration and anchors used. **A)** Sliding X or Magic X, **B)** Equalette, **C)** Quad, and **D)** Cordelette. The anchors were constructed on climbing wall bolts with Enforcer load cells inline with each anchor point. On the right limb was a snap shackle quick release for drop testing (see Evans 2016d for those results). The rope on the far left is a haul rope for lifting the 120.66kg (266lb) load, and was constructed with an inline 3:1 haul system for lifting and lowering the test mass.

Anchors were constructed on two stationary bolts on the Arrillaga Outdoor Education and Recreation Center (AOERC) climbing wall at Stanford University (Figure 1). An Enforcer load cell was connected between the bolts and the two anchor limbs (Figures 1 and 2) to measure the tension in each limb when loaded. A 120.66kg (266lbs) load of four sand bags (Figure 2) was lowered onto each anchor from the side and above. Loading the anchors from the side forced the anchor limbs to change length for the load to come to rest, thus forcing some equalization in the LD anchors. The load was gently stabilized by hand, and the forces on each limb recorded. A bolt failure was simulated and the peak load recorded, however these results are presented in a separate paper on anchor forces during dynamic events (Evans 2016b). The anchors were reused up to ten times or until they broke, so for each anchor there are multiple measurements of loading in each limb with the same load (up to ten).

To determine how evenly different anchors load their limbs, the load held by each limb was divided by the total load held by both limbs, and this is presented as a percentage. This data analysis technique was chosen because all four anchor types had different angles between the limbs, making the total load held different for each anchor type. Calculating a percentage of the load held for each limb factors out the variable of anchor angle, so the results can be compared between anchor types. The difference in loading between the two limbs was calculated by calculating the absolute value of the difference in loading between the two limbs. All the measurements were treated as a population for a given anchor type, and descriptive statistics (average, standard deviation, maximum, minimum, and range) were calculated for comparison. The data are also presented as box and whisker plots.

Once testing of the new cord was completed, additional anchors were tested

Figure 2: The test mass, four sand bags totaling 120.66kg (266lbs), haul system, and ladder for accessing the bolts and load cells. The load is hanging from the haul system here.

constructed of donated used webbing and cord. Samples were mostly lightly used pieces of webbing and cord that were more than ten years old and retired by the organizations that donated them. As many anchors were tested as possible given webbing and cord lengths, and the need to test a variety of anchors. Because each sample had a separate history, the results were not lumped between samples. Rather the limb loading measurements for each sample were treated as a separate population. Consequently, results for each sample are presented independently. Readers are cautioned from drawing broader conclusions from these results because the sample histories are wildly different, but are included to provide additional information with which to develop future hypotheses.

Results

There were minor differences between how each anchor type behaved (Table 2 reports the raw data). On average the Sliding X had the highest difference in loading between limbs (23.8%, N=92), followed by the Equalette (21.8%, N=87), Cordelette (16.4%, N=90), and Quad (14.1%, N=90). However, all anchors showed significant variability in behavior (Figure 3), which largely overlapped with the behavior of the other anchor types. The Sliding X and Equalette behaved similarly, with the Equalette having just slightly better equalization though with a bit more variability. The Quad had the lowest average difference in loading between limbs, and had the least variability of all the anchors. Interestingly the Cordelette anchor, on average, had nearly the lowest average difference in limb loading, but also the greatest variability in results between anchors.

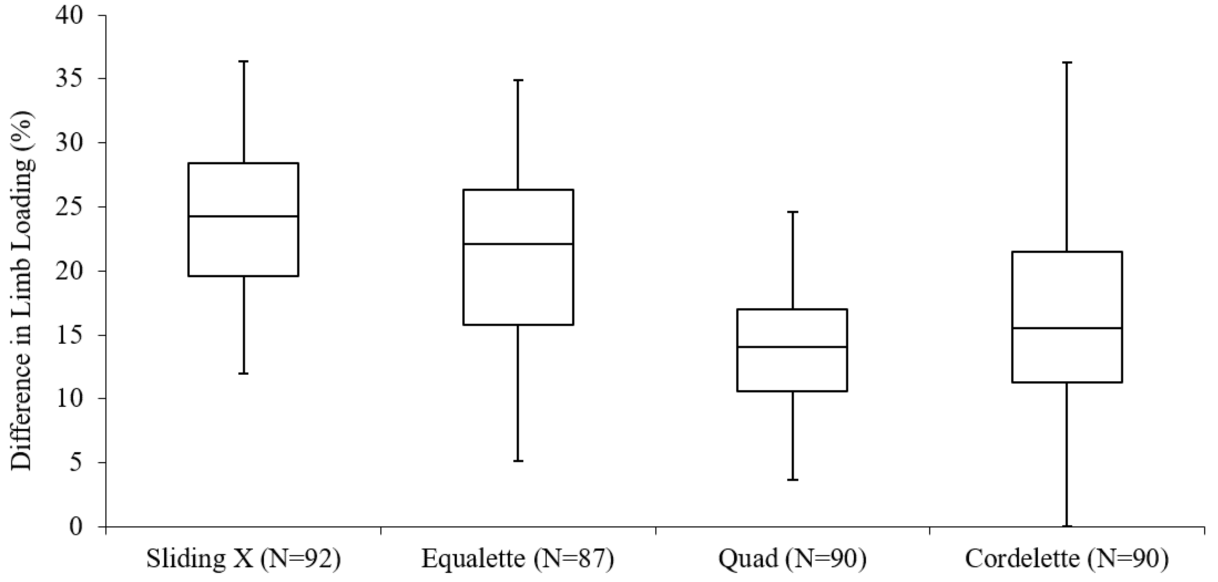

Figure 3: Box and whisker plots depicting the variability in equalization between anchor types. The y-axis is in percent (%) difference in loading between limbs, which equals the absolute difference in percent loading between the two limbs.

To determine the effect of previous dynamic loading on static anchor equalization, the difference in limb loading as a function of drop test was plotted. The anchors with some form of equalization (Sliding X, Equalette, and Quad) all showed no consistent behavior. However, the

Cordelette anchors showed a gradual increase in the difference in loading between the limbs over time (Figure 4).

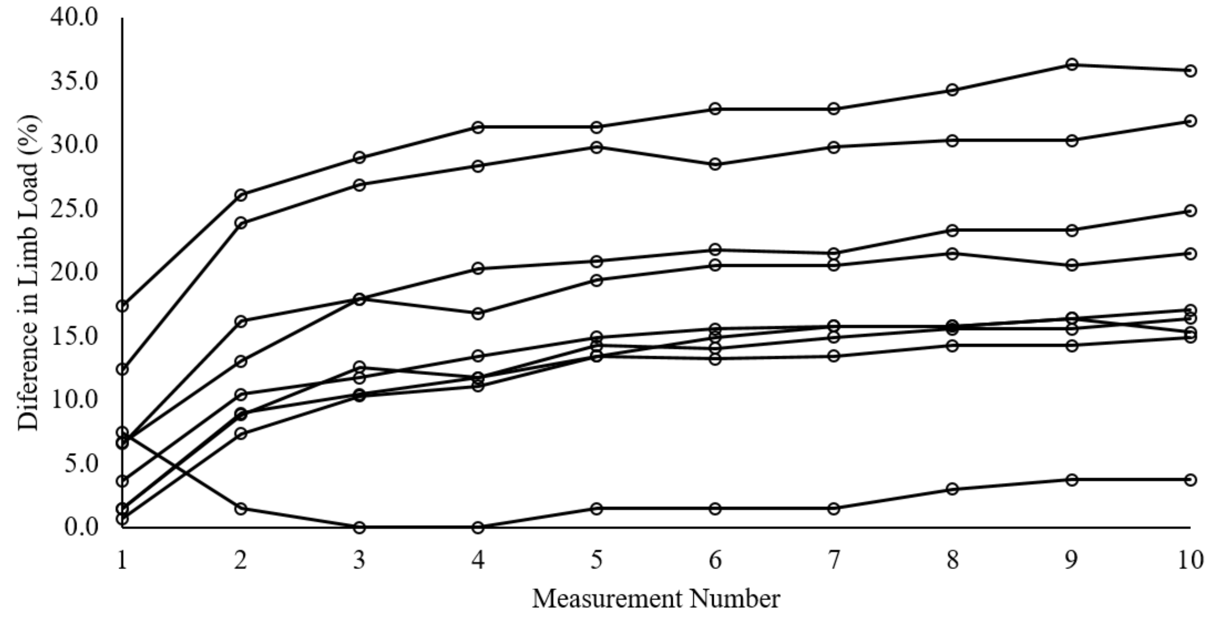

Figure 4: Difference in limb loading of Cordelette anchors (LS anchor) after successive loading. After each measurement a simulated limb failure occurred in which a 120.66kg (266lbs) mass dropped on the focal knot. Over time the knot tightened and lengthened one of the limbs, thus shifting the loading between limbs. The X-axis is the drop test number for each anchor, so moving right the anchor has experienced more drops.

Similar results were not observed in the used webbing and cordage anchors, probably because most of the used anchors were tied with webbing rather than cordage. There is no consistent difference in behavior between the different anchor types (Table 3 reports the raw data, Figure 5). Like webbing anchors (Evans and Truebe 2015), there is more variability in anchor behavior when more data are available, suggesting most studies have insufficient sample sizes to constrain anchor variability, which makes drawing broader conclusions somewhat suspect. What is notable is that anchors built from a variety of constructions (cord vs. webbing) have similar limb loading behaviors. Further data collection is necessary, however, because no pattern emerges when comparing cord to webbing, webbing of different sizes, or cord of different diameters. It is possible patterns would emerge with a more systematic study of anchor performance tied out of each of these constructions, with greater sample sizes, as well as different fiber types (e.g., nylon vs. dyneema vs. Kevlar, etc.). All of the anchors tested here were nylon cord and nylon webbing.

Discussion and Conclusions

Results reported here support those of Frank (2014) and McKently et al. (2007) and show that LD anchors do not necessary share the load equally between limbs. However, it is clearly seen that the LS anchor (Cordelette) sometimes also did a poor job of sharing the load but other times there was no difference between limbs. So these results also support the results of Owen and Naguran’s (2004) that LD anchors often show less equal limb loading than LS anchors, though this is not always the case.

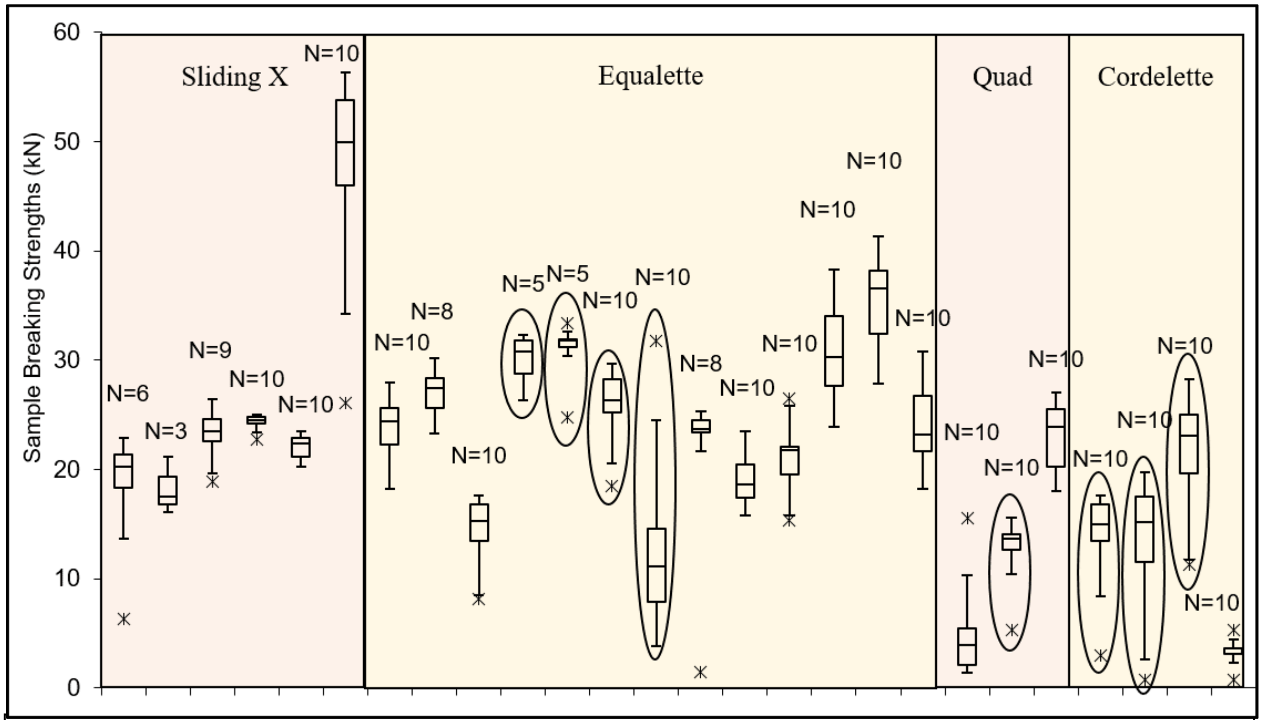

Figure 5: Box and whisker plots showing the loading behaviors of different anchor types constructed of used webbing and cord. Note that most of these anchors are constructed of webbing; anchors built with cord are circled. Asterisks (*) are upper and lower outliers.

So which anchors share the load most effectively? It depends. The Cordelette anchor showed the least absolute difference in loading between limbs (0.8% difference in one trial), however, this LS anchor showed the greatest variability of all the anchor types overall. This variability is probably caused by two factors, the difficulty in tying anchors that share the load equally, and the limb lengths changing over time as the master point knot tightens (Gibbs 2012). This is important because I attempted to build them all the same, so having this much variability indicates that this kind of anchor is highly variable in realistic use, when the user is not as concerned with consistent rigging for research. See also Beverley (2005), Gibbs (2012), and Prattley (2014) for excellent research concerning how variable LS anchor limb loading can be in realistic rigging configurations. The Quad anchor, on the other hand, showed the least variation in performance, even though it was tested in two different configurations. In short, the Quad consistently shows the least variation in limb loading even though the Cordelette anchor showed the least difference in limb loading in any one given trial (Figure 3).

The greater equalization observed in the Quad anchor may be a function of how it was connected to the load. Clipping carabiners directly over the cordage (Figure 1C) rather than through a Sliding X (Figures 1A and 1B) may have resulted in less friction. This would suggest that you can achieve greater equalization in anchors when configured so that the only friction in their movement is between a carabiner and some software, rather than friction of the anchor material against itself (e.g., when the Sliding X moves over itself when equalizing limbs). It is precisely this lack of internal friction that probably led to the decreased average difference in limb loading in the Quad, and the smaller variability in anchor performance.

Generally, anchors with the least friction during equalization showed less difference in loading (greater equalization) than those with more friction. Intuitively this makes sense, meaning that the more force needed to overcome friction, the greater the disparity in loading between limbs. This explains the similar behavior of the Sliding X and the Equalette, which both incorporated the same mechanism to equalize the load between limbs, and explains why the Quad shows greater equalization than either of them (Figure 3).

The change in limb loading over time observed in the Cordelette anchor is readily observable in Figure 4. With more drops, the difference in loading between limbs gradually gets higher, then levels off. This can be explained by the tightening of the overhand focal knot and fisherman's bend lengthening one limb in comparison to the other. This slowly shifts the load to one limb, a process that slowly tapers off as the knots are as tight as can be.

Until this point all comparisons were of static systems, with the load lowered onto the anchors in a controlled manner. Long and Gaines (2013) performed similar research, but they dropped a load on the anchors (Fall Factor 1), and measured how well multipoint anchors equalized the load in a dynamic event. Their results are similar, but not equivalent to, the results here. They found anchor behavior was a function of limb lengths, so their "unequal" results are most comparable to the anchors tested here, which were of unequal lengths. Unlike the data presented here, they found the Cordelette anchor was considerably less equalized than the Sliding X or Equalette, though like this study, Cordelettes showed the greatest variability in behavior (Long and Gaines 2013:168). Like the data reported here, they found the Equalette and Sliding X performed similarly, with the Sliding X a bit worse than the Equalette. It is striking that the Cordelette anchors behaved so poorly in comparison with the Sliding X and the Equalette in their data, compared to the data reported here. Further investigation is warranted to determine why the Cordelette anchor performed so badly. It is possible a small sample size led to skewed results, or in dynamic events Cordelette anchors may simply perform poorly compared to LD anchors. They also found that anchors made out of different materials behaved differently (Long and Gaines 2013:169), a hypothesis the data presented here cannot support or refute.

Frank (2014) and McKently et al. (2007) also report how well LD and LS anchors distribute the load after an anchor point fails in a 3-point anchor. Both report the results of the same suite of tests, and found that both LD and LS anchors did not share the load equally after a dynamic event. The results were highly dependent on the anchor configuration tested, so broader generalizations are challenging. However, because LS anchors have fixed limb lengths, depending on which anchor point fails, nearly all the load could shift to only one of the other anchor points, which was observed in testing. The results of Hayes and Zimmering (Unknown Date) support these conclusion as well. They failed a limb of a three point anchor and found that if an outside limb failed, the remaining limbs experienced higher loads than if a center limb failed. The remaining outside limbs consistently held much lower peak forces than center limbs when an outside limb was cut, demonstrating that during a dynamic event there is unequal loading between the remaining limbs of a LD anchor.

The preponderance of the evidence does not entirely support the idea that LD anchors are more effective at preventing anchor failures built on multiple marginal anchor points by distributing the load. Anchor behavior depends on configuration with well-designed LS anchors out performing a variety of LD anchors. The take home message is that it is more important to engineer an anchor appropriately for the local geometry and expected loading direction (s) than it is to use one kind over another. So use the anchor that is most appropriate for the rigging challenge you face keeping in mind the equalization behaviors of LD anchors reported here and elsewhere (Frank 2014, Hayes and Zimmering Unknown Date, McKently et al. 2007, Owen and Naguran 2004), and the many customization options available for adjusting the load sharing characteristics of LS anchors (Beverley 2005, Gibbs 2012, Prattley 2014).

Acknowledgements

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Table 2: Limb loading raw data, percent of load held for each limb, and absolute difference in percent load held for all 8mm cord anchors.

Sample #	Measurement #	Sliding X					Equalette					Quad					Cordelette				
		Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)
1	1	0.54	0.82	39.7	60.3	20.6	0.51	0.80	38.9	61.1	22.1	0.61	0.73	45.5	54.5	9.0	0.81	0.57	58.7	41.3	17.4
	2	0.47	0.88	34.8	65.2	30.4	0.52	0.81	39.1	60.9	21.8	0.56	0.78	41.8	58.2	16.4	0.87	0.51	63.0	37.0	26.1
	3	0.49	0.85	36.6	63.4	26.9	0.54	0.76	41.5	58.5	16.9	0.55	0.79	41.0	59.0	17.9	0.89	0.49	64.5	35.5	29.0
	4	0.47	0.88	34.8	65.2	30.4	0.52	0.80	39.4	60.6	21.2	0.54	0.77	41.2	58.8	17.6	0.90	0.47	65.7	34.3	31.4
	5	0.49	0.84	36.8	63.2	26.3	0.52	0.81	39.1	60.9	21.8	0.57	0.77	42.5	57.5	14.9	0.90	0.47	65.7	34.3	31.4
	6	0.48	0.86	35.8	64.2	28.4	0.53	0.80	39.8	60.2	20.3	0.56	0.77	42.1	57.9	15.8	0.91	0.46	66.4	33.6	32.8
	7	0.54	0.80	40.3	59.7	19.4	0.53	0.79	40.2	59.8	19.7	0.56	0.77	42.1	57.9	15.8	0.91	0.46	66.4	33.6	32.8
	8	0.44	0.87	33.6	66.4	32.8	0.53	0.79	40.2	59.8	19.7	0.65	0.70	48.1	51.9	3.7	0.92	0.45	67.2	32.8	34.3
	9	0.48	0.82	36.9	63.1	26.2	0.55	0.78	41.4	58.6	17.3	0.56	0.76	42.4	57.6	15.2	0.92	0.43	68.1	31.9	36.3
	10	0.52	0.81	39.1	60.9	21.8	0.52	0.80	39.4	60.6	21.2	0.56	0.79	41.5	58.5	17.0	0.91	0.43	67.9	32.1	35.8
2	1	0.47	0.86	35.3	64.7	29.3	0.49	0.84	36.8	63.2	26.3	0.58	0.77	43.0	57.0	14.1	0.77	0.60	56.2	43.8	12.4
	2	0.50	0.83	37.6	62.4	24.8	0.53	0.79	40.2	59.8	19.7	0.59	0.75	44.0	56.0	11.9	0.83	0.51	61.9	38.1	23.9
	3	0.59	0.75	44.0	56.0	11.9	0.59	0.73	44.7	55.3	10.6	0.58	0.74	43.9	56.1	12.1	0.85	0.49	63.4	36.6	26.9
	4	0.56	0.77	42.1	57.9	15.8	0.55	0.77	41.7	58.3	16.7	0.56	0.73	43.4	56.6	13.2	0.86	0.48	64.2	35.8	28.4
	5	0.57	0.76	42.9	57.1	14.3	0.52	0.82	38.8	61.2	22.4	0.59	0.73	44.7	55.3	10.6	0.87	0.47	64.9	35.1	29.9
	6	0.46	0.84	35.4	64.6	29.2	0.51	0.79	39.2	60.8	21.5	0.59	0.74	44.4	55.6	11.3	0.88	0.49	64.2	35.8	28.5
	7	0.46	0.86	34.8	65.2	30.3	0.59	0.74	44.4	55.6	11.3	0.59	0.73	44.7	55.3	10.6	0.87	0.47	64.9	35.1	29.9
	8	0.56	0.77	42.1	57.9	15.8	0.56	0.77	42.1	57.9	15.8	0.59	0.73	44.7	55.3	10.6	0.88	0.47	65.2	34.8	30.4
	9	0.48	0.85	36.1	63.9	27.8	0.62	0.73	45.9	54.1	8.1	0.60	0.72	45.5	54.5	9.1	0.88	0.47	65.2	34.8	30.4
	10	-	-	-	-	-	-	-	-	-	-	0.63	0.71	47.0	53.0	6.0	0.89	0.46	65.9	34.1	31.9
3	1	0.46	0.86	34.8	65.2	30.3	0.53	0.80	39.8	60.2	20.3	0.54	0.79	40.6	59.4	18.8	0.72	0.63	53.3	46.7	6.7
	2	0.42	0.90	31.8	68.2	36.4	0.57	0.73	43.8	56.2	12.3	0.62	0.73	45.9	54.1	8.1	0.78	0.60	56.5	43.5	13.0
	3	0.58	0.77	43.0	57.0	14.1	0.58	0.76	43.3	56.7	13.4	0.62	0.76	44.9	55.1	10.1	0.79	0.55	59.0	41.0	17.9
	4	0.52	0.78	40.0	60.0	20.0	0.59	0.75	44.0	56.0	11.9	0.64	0.76	45.7	54.3	8.6	0.80	0.57	58.4	41.6	16.8
	5	0.55	0.77	41.7	58.3	16.7	0.64	0.71	47.4	52.6	5.2	0.60	0.80	42.9	57.1	14.3	0.80	0.54	59.7	40.3	19.4
	6	0.56	0.76	42.4	57.6	15.2	0.59	0.76	43.7	56.3	12.6	0.59	0.81	42.1	57.9	15.7	0.82	0.54	60.3	39.7	20.6
	7	0.53	0.77	40.8	59.2	18.5	0.56	0.78	41.8	58.2	16.4	0.61	0.79	43.6	56.4	12.9	0.82	0.54	60.3	39.7	20.6
	8	0.57	0.76	42.9	57.1	14.3	0.56	0.77	42.1	57.9	15.8	0.61	0.79	43.6	56.4	12.9	0.82	0.53	60.7	39.3	21.5
	9	0.51	0.80	38.9	61.1	22.1	0.63	0.70	47.4	52.6	5.3	0.66	0.75	46.8	53.2	6.4	0.82	0.54	60.3	39.7	20.6
	10	0.51	0.83	38.1	61.9	23.9	0.56	0.77	42.1	57.9	15.8	0.59	0.79	42.8	57.2	14.5	0.82	0.53	60.7	39.3	21.5

Table 2: Continued

4	1	0.43	0.90	32.3	67.7	35.3	0.53	0.80	39.8	60.2	20.3	0.59	0.79	42.8	57.2	14.5	0.62	0.72	46.3	53.7	7.5
	2	0.48	0.84	36.4	63.6	27.3	0.55	0.78	41.4	58.6	17.3	0.63	0.77	45.0	55.0	10.0	0.66	0.68	49.3	50.7	1.5
	3	0.56	0.77	42.1	57.9	15.8	0.59	0.77	43.4	56.6	13.2	0.62	0.78	44.3	55.7	11.4	0.67	0.67	50.0	50.0	0.0
	4	0.56	0.77	42.1	57.9	15.8	0.58	0.74	43.9	56.1	12.1	0.63	0.76	45.3	54.7	9.4	0.68	0.68	50.0	50.0	0.0
	5	0.47	0.85	35.6	64.4	28.8	0.59	0.77	43.4	56.6	13.2	0.63	0.74	46.0	54.0	8.0	0.69	0.67	50.7	49.3	1.5
	6	0.57	0.77	42.5	57.5	14.9	0.63	0.73	46.3	53.7	7.4	0.58	0.80	42.0	58.0	15.9	0.69	0.67	50.7	49.3	1.5
	7	0.52	0.79	39.7	60.3	20.6	0.61	0.75	44.9	55.1	10.3	0.60	0.79	43.2	56.8	13.7	0.69	0.67	50.7	49.3	1.5
	8	0.48	0.84	36.4	63.6	27.3	0.63	0.72	46.7	53.3	6.7	0.62	0.75	45.3	54.7	9.5	0.68	0.64	51.5	48.5	3.0
	9	0.56	0.80	41.2	58.8	17.6	0.63	0.72	46.7	53.3	6.7	0.66	0.72	47.8	52.2	4.3	0.69	0.64	51.9	48.1	3.8
	10	0.52	0.81	39.1	60.9	21.8	-	-	-	-	-	0.62	0.76	44.9	55.1	10.1	0.69	0.64	51.9	48.1	3.8
5	1	0.55	0.81	40.4	59.6	19.1	0.48	0.82	36.9	63.1	26.2	0.59	0.74	44.4	55.6	11.3	0.71	0.66	51.8	48.2	3.6
	2	0.49	0.83	37.1	62.9	25.8	0.50	0.83	37.6	62.4	24.8	0.61	0.74	45.2	54.8	9.6	0.74	0.60	55.2	44.8	10.4
	3	0.49	0.83	37.1	62.9	25.8	0.46	0.87	34.6	65.4	30.8	0.56	0.79	41.5	58.5	17.0	0.76	0.60	55.9	44.1	11.8
	4	0.50	0.82	37.9	62.1	24.2	0.49	0.84	36.8	63.2	26.3	0.59	0.75	44.0	56.0	11.9	0.76	0.58	56.7	43.3	13.4
	5	0.52	0.80	39.4	60.6	21.2	0.48	0.87	35.6	64.4	28.9	0.62	0.73	45.9	54.1	8.1	0.77	0.57	57.5	42.5	14.9
	6	0.53	0.82	39.3	60.7	21.5	0.51	0.83	38.1	61.9	23.9	0.57	0.76	42.9	57.1	14.3	0.78	0.57	57.8	42.2	15.6
	7	0.47	0.85	35.6	64.4	28.8	0.49	0.83	37.1	62.9	25.8	0.59	0.75	44.0	56.0	11.9	0.77	0.56	57.9	42.1	15.8
	8	-	-	-	-	-	0.42	0.87	32.6	67.4	34.9	0.61	0.73	45.5	54.5	9.0	0.77	0.56	57.9	42.1	15.8
	9	-	-	-	-	-	0.47	0.84	35.9	64.1	28.2	0.60	0.76	44.1	55.9	11.8	0.78	0.56	58.2	41.8	16.4
	10	-	-	-	-	-	0.48	0.81	37.2	62.8	25.6	0.58	0.77	43.0	57.0	14.1	0.79	0.58	57.7	42.3	15.3
6	1	0.46	0.85	35.1	64.9	29.8	0.48	0.83	36.6	63.4	26.7	0.53	0.79	40.2	59.8	19.7	0.68	0.66	50.7	49.3	1.5
	2	0.49	0.84	36.8	63.2	26.3	0.59	0.74	44.4	55.6	11.3	0.56	0.79	41.5	58.5	17.0	0.73	0.61	54.5	45.5	9.0
	3	0.51	0.81	38.6	61.4	22.7	0.55	0.77	41.7	58.3	16.7	0.51	0.84	37.8	62.2	24.4	0.74	0.60	55.2	44.8	10.4
	4	0.57	0.79	41.9	58.1	16.2	0.49	0.82	37.4	62.6	25.2	0.58	0.76	43.3	56.7	13.4	0.76	0.60	55.9	44.1	11.8
	5	0.50	0.84	37.3	62.7	25.4	0.59	0.75	44.0	56.0	11.9	0.58	0.77	43.0	57.0	14.1	0.76	0.58	56.7	43.3	13.4
	6	0.51	0.81	38.6	61.4	22.7	0.60	0.75	44.4	55.6	11.1	0.51	0.83	38.1	61.9	23.9	0.77	0.57	57.5	42.5	14.9
	7	0.53	0.81	39.6	60.4	20.9	0.45	0.86	34.4	65.6	31.3	0.62	0.73	45.9	54.1	8.1	0.77	0.56	57.9	42.1	15.8
	8	0.45	0.87	34.1	65.9	31.8	0.56	0.78	41.8	58.2	16.4	0.49	0.81	37.7	62.3	24.6	0.77	0.56	57.9	42.1	15.8
	9	0.49	0.83	37.1	62.9	25.8	0.51	0.80	38.9	61.1	22.1	0.51	0.81	38.6	61.4	22.7	0.78	0.56	58.2	41.8	16.4
	10	-	-	-	-	-	-	-	-	-	-	0.59	0.75	44.0	56.0	11.9	0.79	0.56	58.5	41.5	17.0
7	1	0.55	0.78	41.4	58.6	17.3	0.45	0.89	33.6	66.4	32.8	0.52	0.80	39.4	60.6	21.2	0.68	0.69	49.6	50.4	0.7
	2	0.57	0.78	42.2	57.8	15.6	0.50	0.84	37.3	62.7	25.4	0.65	0.70	48.1	51.9	3.7	0.73	0.63	53.7	46.3	7.4
	3	0.49	0.83	37.1	62.9	25.8	0.47	0.83	36.2	63.8	27.7	0.63	0.78	44.7	55.3	10.6	0.75	0.61	55.1	44.9	10.3
	4	0.47	0.86	35.3	64.7	29.3	0.48	0.84	36.4	63.6	27.3	0.56	0.78	41.8	58.2	16.4	0.75	0.60	55.6	44.4	11.1
	5	0.45	0.86	34.4	65.6	31.3	0.50	0.82	37.9	62.1	24.2	0.56	0.80	41.2	58.8	17.6	0.76	0.58	56.7	43.3	13.4
	6	0.47	0.84	35.9	64.1	28.2	0.49	0.86	36.3	63.7	27.4	0.54	0.79	40.6	59.4	18.8	0.77	0.59	56.6	43.4	13.2
	7	0.47	0.84	35.9	64.1	28.2	0.49	0.83	37.1	62.9	25.8	0.60	0.75	44.4	55.6	11.1	0.76	0.58	56.7	43.3	13.4
	8	-	-	-	-	-	0.49	0.85	36.6	63.4	26.9	0.59	0.77	43.4	56.6	13.2	0.76	0.57	57.1	42.9	14.3
	9	-	-	-	-	-	0.49	0.83	37.1	62.9	25.8	0.62	0.73	45.9	54.1	8.1	0.76	0.57	57.1	42.9	14.3
	10	-	-	-	-	-	0.50	0.83	37.6	62.4	24.8	0.56	0.79	41.5	58.5	17.0	0.77	0.57	57.5	42.5	14.9

Table 2: Continued

8	1	0.50	0.82	37.9	62.1	24.2	0.45	0.88	33.8	66.2	32.3	0.54	0.82	39.7	60.3	20.6	0.73	0.64	53.3	46.7	6.6
	2	0.52	0.80	39.4	60.6	21.2	0.45	0.87	34.1	65.9	31.8	0.60	0.76	44.1	55.9	11.8	0.79	0.57	58.1	41.9	16.2
	3	0.49	0.83	37.1	62.9	25.8	0.47	0.87	35.1	64.9	29.9	0.51	0.83	38.1	61.9	23.9	0.79	0.55	59.0	41.0	17.9
	4	0.47	0.85	35.6	64.4	28.8	0.49	0.82	37.4	62.6	25.2	0.52	0.84	38.2	61.8	23.5	0.80	0.53	60.2	39.8	20.3
	5	0.54	0.77	41.2	58.8	17.6	0.58	0.75	43.6	56.4	12.8	0.51	0.84	37.8	62.2	24.4	0.81	0.53	60.4	39.6	20.9
	6	0.52	0.81	39.1	60.9	21.8	0.49	0.84	36.8	63.2	26.3	0.57	0.79	41.9	58.1	16.2	0.81	0.52	60.9	39.1	21.8
	7	0.51	0.80	38.9	61.1	22.1	0.43	0.88	32.8	67.2	34.4	0.54	0.82	39.7	60.3	20.6	0.82	0.53	60.7	39.3	21.5
	8	0.43	0.87	33.1	66.9	33.8	0.50	0.83	37.6	62.4	24.8	0.54	0.80	40.3	59.7	19.4	0.82	0.51	61.7	38.3	23.3
	9	0.49	0.81	37.7	62.3	24.6	0.49	0.84	36.8	63.2	26.3	0.64	0.72	47.1	52.9	5.9	0.82	0.51	61.7	38.3	23.3
	10	0.45	0.87	34.1	65.9	31.8	0.49	0.82	37.4	62.6	25.2	0.56	0.80	41.2	58.8	17.6	0.83	0.50	62.4	37.6	24.8
9	1	0.55	0.80	40.7	59.3	18.5	0.46	0.87	34.6	65.4	30.8	0.55	0.82	40.1	59.9	19.7	0.68	0.66	50.7	49.3	1.5
	2	0.46	0.87	34.6	65.4	30.8	0.53	0.81	39.6	60.4	20.9	0.57	0.79	41.9	58.1	16.2	0.74	0.62	54.4	45.6	8.8
	3	0.57	0.76	42.9	57.1	14.3	0.51	0.83	38.1	61.9	23.9	0.53	0.81	39.6	60.4	20.9	0.76	0.59	56.3	43.7	12.6
	4	0.55	0.78	41.4	58.6	17.3	0.52	0.82	38.8	61.2	22.4	0.58	0.77	43.0	57.0	14.1	0.76	0.60	55.9	44.1	11.8
	5	0.51	0.82	38.3	61.7	23.3	0.49	0.83	37.1	62.9	25.8	0.60	0.73	45.1	54.9	9.8	0.76	0.57	57.1	42.9	14.3
	6	0.54	0.79	40.6	59.4	18.8	0.44	0.88	33.3	66.7	33.3	0.54	0.81	40.0	60.0	20.0	0.77	0.58	57.0	43.0	14.1
	7	0.52	0.79	39.7	60.3	20.6	0.43	0.87	33.1	66.9	33.8	0.59	0.77	43.4	56.6	13.2	0.77	0.57	57.5	42.5	14.9
	8	0.52	0.79	39.7	60.3	20.6	0.55	0.79	41.0	59.0	17.9	0.54	0.80	40.3	59.7	19.4	0.78	0.57	57.8	42.2	15.6
	9	0.53	0.79	40.2	59.8	19.7	0.45	0.87	34.1	65.9	31.8	0.57	0.78	42.2	57.8	15.6	0.78	0.57	57.8	42.2	15.6
	10	0.50	0.80	38.5	61.5	23.1	0.43	0.89	32.6	67.4	34.8	0.58	0.77	43.0	57.0	14.1	0.78	0.56	58.2	41.8	16.4
10	1	0.48	0.83	36.6	63.4	26.7	**Equalette**			Average	21.3	**Quad**			Average	14.1	**Cordelette**			Average	16.4
	2	0.50	0.82	37.9	62.1	24.2				Standard Deviation	7.7				Standard Deviation	5.0				Standard Deviation	9.3
	3	0.46	0.83	35.7	64.3	28.7				Maximum	34.9				Maximum	24.6				Maximum	36.3
	4	0.50	0.79	38.8	61.2	22.5				Minimum	5.2				Minimum	3.7				Minimum	0.0
	5	0.44	0.84	34.4	65.6	31.3				Range	29.7				Range	20.9				Range	36.3
	6	0.45	0.86	34.4	65.6	31.3															
	7	0.52	0.79	39.7	60.3	20.6															
	8	0.44	0.83	34.6	65.4	30.7															
	9	0.49	0.82	37.4	62.6	25.2															
	10	0.49	0.82	37.4	62.6	25.2															
		Sliding X			Average	23.8															
					Standard Deviation	5.7															
					Maximum	36.4															
					Minimum	11.9															
					Range	24.4															

Table 3: Limb loading raw data, percent of load held for each limb, and absolute difference in percent load held for all used software anchors.

Measurement #	Sliding X, Sample #1, 16mm web					Sliding X, Sample #2, 16mm web					Sliding X, Sample #3, 25mm web					Sliding X, Sample #4, 25mm web				
	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)
1	0.67	0.76	46.9	53.1	6.3	0.60	0.83	42.0	58.0	16.1	0.56	0.83	40.3	59.7	19.4	0.50	0.82	37.9	62.1	24.2
2	0.56	0.84	40.0	60.0	20.0	0.56	0.86	39.4	60.6	21.1	0.50	0.86	36.8	63.2	26.5	0.50	0.82	37.9	62.1	24.2
3	0.56	0.87	39.2	60.8	21.7	0.59	0.84	41.3	58.7	17.5	0.52	0.83	38.5	61.5	23.0	0.50	0.83	37.6	62.4	24.8
4	0.54	0.86	38.6	61.4	22.9						0.53	0.84	38.7	61.3	22.6	0.50	0.83	37.6	62.4	24.8
5	0.58	0.83	41.1	58.9	17.7						0.52	0.84	38.2	61.8	23.5	0.50	0.81	38.2	61.8	23.7
6	0.56	0.85	39.7	60.3	20.6						0.56	0.82	40.6	59.4	18.8	0.50	0.82	37.9	62.1	24.2
7											0.52	0.86	37.7	62.3	24.6	0.50	0.83	37.6	62.4	24.8
8											0.51	0.87	37.0	63.0	26.1	0.51	0.81	38.6	61.4	22.7
9											0.51	0.83	38.1	61.9	23.9	0.51	0.85	37.5	62.5	25.0
10																0.50	0.83	37.6	62.4	24.8
#	Sliding X, Sample #5, 25mm web					Sliding X, Sample #6, 19mm web														
1	0.53	0.80	39.8	60.2	20.3	0.51	0.87	37.0	63.0	26.1										
2	0.54	0.82	39.7	60.3	20.6	0.36	0.98	26.9	73.1	46.3										
3	0.52	0.81	39.1	60.9	21.8	0.30	1.04	22.4	77.6	55.2										
4	0.51	0.81	38.6	61.4	22.7	0.40	0.97	29.2	70.8	41.6										
5	0.53	0.81	39.6	60.4	20.9	0.34	1.02	25.0	75.0	50.0										
6	0.52	0.83	38.5	61.5	23.0	0.33	1.03	24.3	75.7	51.5										
7	0.52	0.82	38.8	61.2	22.4	0.30	1.02	22.7	77.3	54.5										
8	0.52	0.82	38.8	61.2	22.4	0.33	0.99	25.0	75.0	50.0										
9	0.52	0.83	38.5	61.5	23.0	0.29	1.04	21.8	78.2	56.4										
10	0.52	0.84	38.2	61.8	23.5	0.36	0.97	27.1	72.9	45.9										

#	Quad, Sample #1, 25mm web					Quad, Sample #2, 5mm cord					Quad, Sample #3, 25mm web				
1	0.78	0.63	55.3	44.7	10.6	0.62	0.69	47.3	52.7	5.3	0.51	0.86	37.2	62.8	25.5
2	0.73	0.65	52.9	47.1	5.8	0.60	0.77	43.8	56.2	12.4	0.56	0.83	40.3	59.7	19.4
3	0.69	0.71	49.3	50.7	1.4	0.58	0.77	43.0	57.0	14.1	0.53	0.84	38.7	61.3	22.6
4	0.82	0.60	57.7	42.3	15.5	0.59	0.77	43.4	56.6	13.2	0.57	0.82	41.0	59.0	18.0
5	0.67	0.73	47.9	52.1	4.3	0.57	0.77	42.5	57.5	14.9	0.53	0.86	38.1	61.9	23.7
6	0.69	0.72	48.9	51.1	2.1	0.57	0.78	42.2	57.8	15.6	0.51	0.86	37.2	62.8	25.5
7	0.67	0.73	47.9	52.1	4.3	0.58	0.77	43.0	57.0	14.1	0.52	0.85	38.0	62.0	24.1
8	0.68	0.71	48.9	51.1	2.2	0.59	0.75	44.0	56.0	11.9	0.51	0.86	37.2	62.8	25.5
9	0.67	0.72	48.2	51.8	3.6	0.58	0.77	43.0	57.0	14.1	0.56	0.83	40.3	59.7	19.4
10	0.68	0.70	49.3	50.7	1.4	0.59	0.77	43.4	56.6	13.2	0.50	0.87	36.5	63.5	27.0

Table 3: Continued

Measurement #	Cordelette, Sample #1, 5mm cord					Cordelette, Sample #2, 6mm cord					Cordelette, Sample #3, 6mm cord					Cordelette, Sample #4, 25mm web				
	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)
1	0.70	0.66	51.5	48.5	2.9	0.66	0.65	50.4	49.6	0.8	0.74	0.59	55.6	44.4	11.3	0.69	0.68	50.4	49.6	0.7
2	0.75	0.60	55.6	44.4	11.1	0.71	0.60	54.2	45.8	8.4	0.79	0.54	59.4	40.6	18.8	0.70	0.67	51.1	48.9	2.2
3	0.77	0.58	57.0	43.0	14.1	0.73	0.59	55.3	44.7	10.6	0.71	0.52	57.7	42.3	15.4	0.70	0.63	52.6	47.4	5.3
4	0.77	0.59	56.6	43.4	13.2	0.75	0.56	57.3	42.7	14.5	0.82	0.52	61.2	38.8	22.4	0.70	0.66	51.5	48.5	2.9
5	0.78	0.57	57.8	42.2	15.6	0.76	0.57	57.1	42.9	14.3	0.82	0.51	61.7	38.3	23.3	0.71	0.66	51.8	48.2	3.6
6	0.79	0.57	58.1	41.9	16.2	0.77	0.56	57.9	42.1	15.8	0.83	0.52	61.5	38.5	23.0	0.71	0.66	51.8	48.2	3.6
7	0.79	0.59	57.2	42.8	14.5	0.77	0.54	58.8	41.2	17.6	0.83	0.51	61.9	38.1	23.9	0.71	0.66	51.8	48.2	3.6
8	0.79	0.56	58.5	41.5	17.0	0.78	0.55	58.6	41.4	17.3	0.85	0.50	63.0	37.0	25.9	0.71	0.66	51.8	48.2	3.6
9	0.79	0.56	58.5	41.5	17.0	0.79	0.54	59.4	40.6	18.8	0.84	0.50	62.7	37.3	25.4	0.70	0.65	51.9	48.1	3.7
10	0.80	0.56	58.8	41.2	17.6	0.79	0.53	59.8	40.2	19.7	0.84	0.47	64.1	35.9	28.2	0.71	0.66	51.8	48.2	3.6

#	Equalette, Sample #1, 16mm web					Equalette, Sample #2, 16mm web					Equalette, Sample #3, 25mm web					Equalette, Sample #4, 5mm cord				
1	0.50	0.86	36.8	63.2	26.5	0.51	0.82	38.3	61.7	23.3	0.56	0.80	41.2	58.8	17.6	0.47	0.85	35.6	64.4	28.8
2	0.50	0.85	37.0	63.0	25.9	0.50	0.84	37.3	62.7	25.4	0.56	0.77	42.1	57.9	15.8	0.49	0.84	36.8	63.2	26.3
3	0.52	0.84	38.2	61.8	23.5	0.48	0.83	36.6	63.4	26.7	0.56	0.80	41.2	58.8	17.6	0.45	0.85	34.6	65.4	30.8
4	0.56	0.81	40.9	59.1	18.2	0.47	0.84	35.9	64.1	28.2	0.57	0.76	42.9	57.1	14.3	0.45	0.88	33.8	66.2	32.3
5	0.51	0.84	37.8	62.2	24.4	0.47	0.84	35.9	64.1	28.2	0.59	0.77	43.4	56.6	13.2	0.45	0.87	34.1	65.9	31.8
6	0.52	0.80	39.4	60.6	21.2	0.46	0.83	35.7	64.3	28.7	0.57	0.79	41.9	58.1	16.2					
7	0.51	0.84	37.8	62.2	24.4	0.45	0.84	34.9	65.1	30.2	0.59	0.74	44.4	55.6	11.3					
8	0.49	0.87	36.0	64.0	27.9	0.49	0.83	37.1	62.9	25.8	0.58	0.78	42.6	57.4	14.7					
9	0.52	0.81	39.1	60.9	21.8						0.62	0.73	45.9	54.1	8.1					
10	0.50	0.83	37.6	62.4	24.8						0.56	0.79	41.5	58.5	17.0					
#	Equalette, Sample #5, 5mm cord					Equalette, Sample #6, 6mm cord					Equalette, Sample #7, 6mm cord					Equalette, Sample #8, 25mm web				
1	0.44	0.84	34.4	65.6	31.3	0.48	0.82	36.9	63.1	26.2	0.44	0.85	34.1	65.9	31.8	0.52	0.84	38.2	61.8	23.5
2	0.45	0.87	34.1	65.9	31.8	0.48	0.80	37.5	62.5	25.0	0.60	0.70	46.2	53.8	7.7	0.51	0.83	38.1	61.9	23.9
3	0.43	0.86	33.3	66.7	33.3	0.49	0.78	38.6	61.4	22.8	0.59	0.71	45.4	54.6	9.2	0.50	0.84	37.3	62.7	25.4
4	0.44	0.85	34.1	65.9	31.8	0.49	0.83	37.1	62.9	25.8	0.52	0.75	40.9	59.1	18.1	0.51	0.84	37.8	62.2	24.4
5	0.50	0.83	37.6	62.4	24.8	0.53	0.77	40.8	59.2	18.5	0.57	0.74	43.5	56.5	13.0	0.52	0.84	38.2	61.8	23.5
6						0.47	0.82	36.4	63.6	27.1	0.62	0.69	47.3	52.7	5.3	0.52	0.83	38.5	61.5	23.0
7						0.45	0.83	35.2	64.8	29.7	0.55	0.73	43.0	57.0	14.1	0.70	0.68	50.7	49.3	1.4
8						0.46	0.83	35.7	64.3	28.7	0.63	0.68	48.1	51.9	3.8	0.50	0.83	37.6	62.4	24.8
9						0.47	0.81	36.7	63.3	26.6	0.55	0.74	42.6	57.4	14.7					
10						0.46	0.83	35.7	64.3	28.7	0.59	0.70	45.7	54.3	8.5					

Table 3: Continued

Measurement #	Equalette, Sample #9, 25mm web					Equalette, Sample #10, 25mm web					Equalette, Sample #11, 25mm web					Equalette, Sample #12, 25mm web				
	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)	Limb #1 Load (kN)	Limb #2 Load (kN)	Limb #1 Load (%)	Limb #2 Load (%)	Difference Between Limbs (%)
1	0.56	0.79	41.5	58.5	17.0	0.58	0.79	42.3	57.7	15.3	0.46	0.86	34.8	65.2	30.3	0.48	0.85	36.1	63.9	27.8
2	0.54	0.82	39.7	60.3	20.6	0.57	0.80	41.6	58.4	16.8	0.47	0.87	35.1	64.9	29.9	0.46	0.87	34.6	65.4	30.8
3	0.52	0.84	38.2	61.8	23.5	0.53	0.83	39.0	61.0	22.1	0.44	0.88	33.3	66.7	33.3	0.46	0.88	34.3	65.7	31.3
4	0.56	0.77	42.1	57.9	15.8	0.53	0.82	39.3	60.7	21.5	0.44	0.90	32.8	67.2	34.3	0.42	0.93	31.1	68.9	37.8
5	0.54	0.79	40.6	59.4	18.8	0.54	0.81	40.0	60.0	20.0	0.50	0.86	36.8	63.2	26.5	0.39	0.94	29.3	70.7	41.4
6	0.55	0.80	40.7	59.3	18.5	0.54	0.80	40.3	59.7	19.4	0.49	0.85	36.6	63.4	26.9	0.43	0.91	32.1	67.9	35.8
7	0.52	0.80	39.4	60.6	21.2	0.53	0.83	39.0	61.0	22.1	0.51	0.83	38.1	61.9	23.9	0.40	0.93	30.1	69.9	39.8
8	0.55	0.80	40.7	59.3	18.5	0.51	0.83	38.1	61.9	23.9	0.44	0.90	32.8	67.2	34.3	0.41	0.92	30.8	69.2	38.3
9	0.56	0.79	41.5	58.5	17.0	0.50	0.86	36.8	63.2	26.5	0.41	0.92	30.8	69.2	38.3	0.43	0.91	32.1	67.9	35.8
10	0.54	0.81	40.0	60.0	20.0	0.53	0.83	39.0	61.0	22.1	0.47	0.88	34.8	65.2	30.4	0.42	0.92	31.3	68.7	37.3

#	Equalette, Sample #13, 25mm web				
1	0.54	0.83	39.4	60.6	21.2
2	0.50	0.87	36.5	63.5	27.0
3	0.56	0.81	40.9	59.1	18.2
4	0.46	0.87	34.6	65.4	30.8
5	0.50	0.85	37.0	63.0	25.9
6	0.53	0.82	39.3	60.7	21.5
7	0.48	0.89	35.0	65.0	29.9
8	0.52	0.85	38.0	62.0	24.1
9	0.52	0.82	38.8	61.2	22.4
10	0.53	0.83	39.0	61.0	22.1